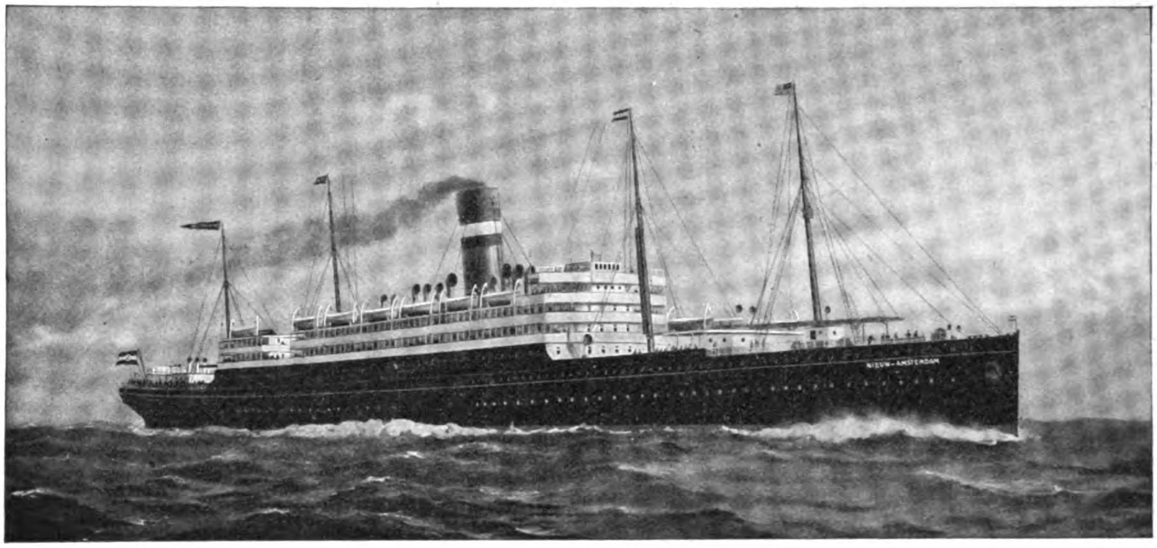
# THE MARINE REVIEW

VOL. XXXIII. CLEVELAND, MAY 3, 1906. No. 18.

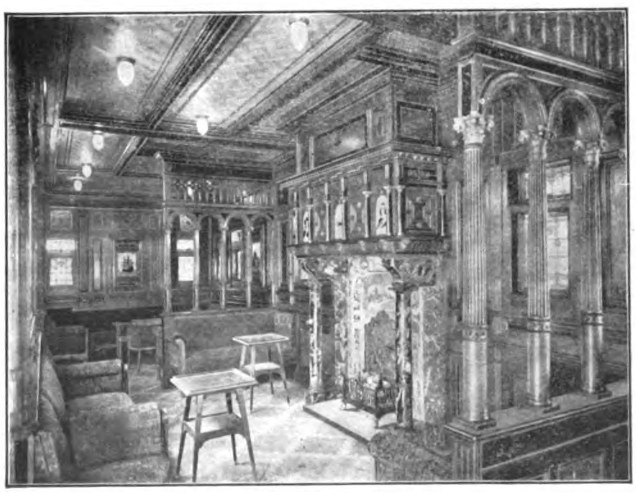
## TWIN-SCREW STEAMSHIP NEW AMSTERDAM.

The steel, twin-screw steamship New Amsterdam is the latest addition to the passenger fleet of the Holland-American line. She was built at Belfast, Ireland, at the yards of Messrs. Harland & Wolff, and was launched on Sept. 28, 1905. She sailed from Rotterdam on April 7, on her maiden trans-Atlantic trip.

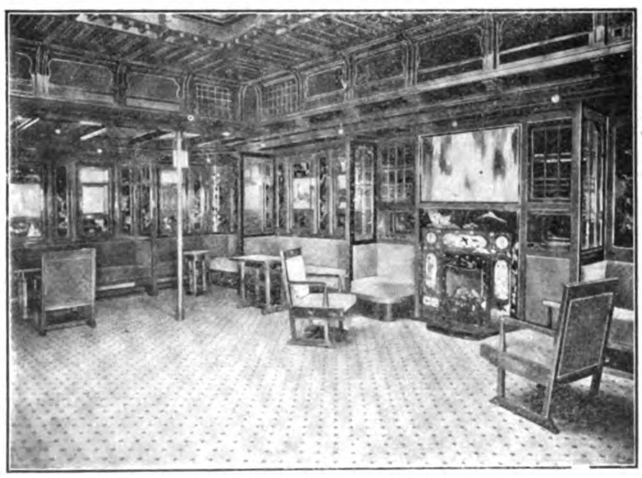


TWIN SCREW STEAMSHIP NEW AMSTERDAM.

The New Amsterdam is not an ocean flyer. She has a speed of 16 knots, and is expected, leaving New York on Wednesday morning, to land her passengers at Boulogne-sur-Mer on Friday morning of the following week, which means arrival at either Paris or London on Friday afternoon. The steamer's dimensions are: Length, 615 ft.; beam, 68½ ft.; depth, 48 ft. She measures 17,258 gross register tons, with a displacement of 30,200 tons. Like the other steamers of the Holland-America line, she is constructed of steel, provided with bilge keels, and has two separate sets of quadruple-expansion engines of 10,000 H. P., each set working independently of the other,

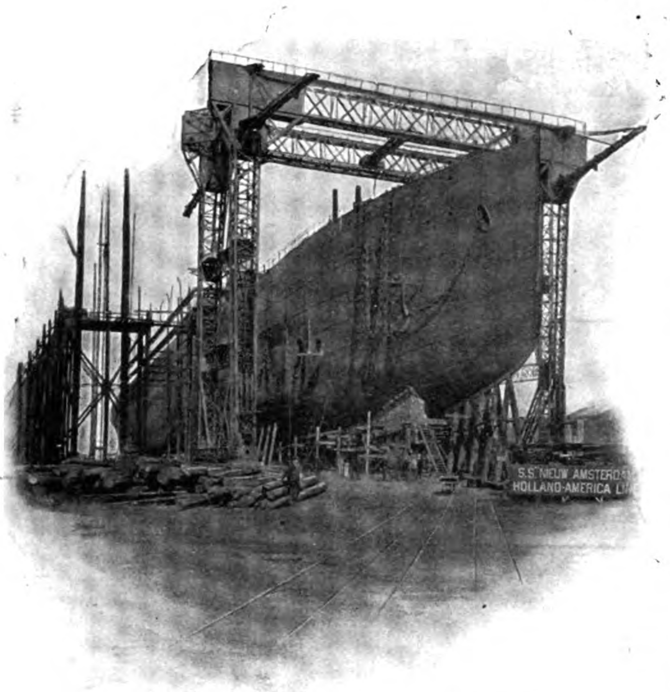


DUTCH FIREPLACE IN THE SMOKING ROOM.



CORNER OF THE JAPANESE TEA ROOM.

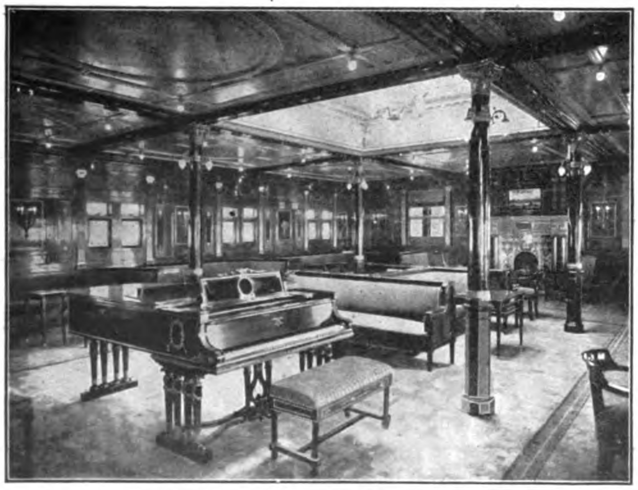
and each being capable of running the steamer across the Atlantic without the least difficulty. Four powerful dynamos furnish the steamer throughout with electric light. A double bottom extends over the entire length of the



BOW VIEW OF NEW AMSTERDAM AT LAUNCHING.

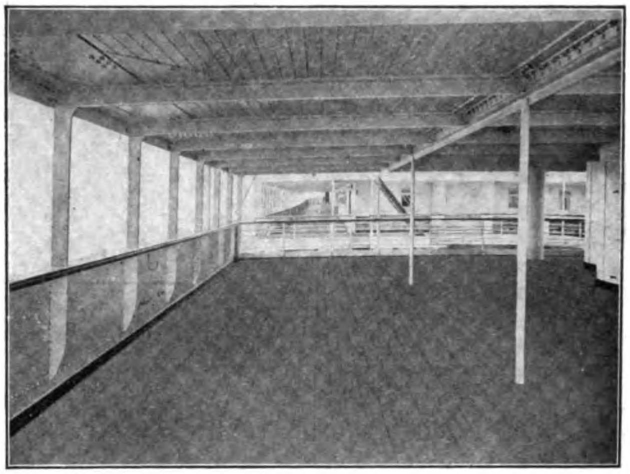
ship. Twelve bulkheads extend to the upper deck, dividing the ship into thirteen water-tight compartments, and a water-tight bulkhead divides the boiler room into two different compartments, thus giving the steamer two entirely separate sets of boilers.

Five decks are set apart for the accommodation of passengers. The first cabin staterooms, accommodating 430 passengers, are situated on the upper deck, saloon deck and bridge deck. These rooms are remarkably spacious, are excellently ventilated, and accommodate two or three passengers each. In the arrangement of its cabins the New Amsterdam will introduce an entirely new system,



THE WELL-LIGHTED AND ATTRACTIVE MUSIC ROOM.

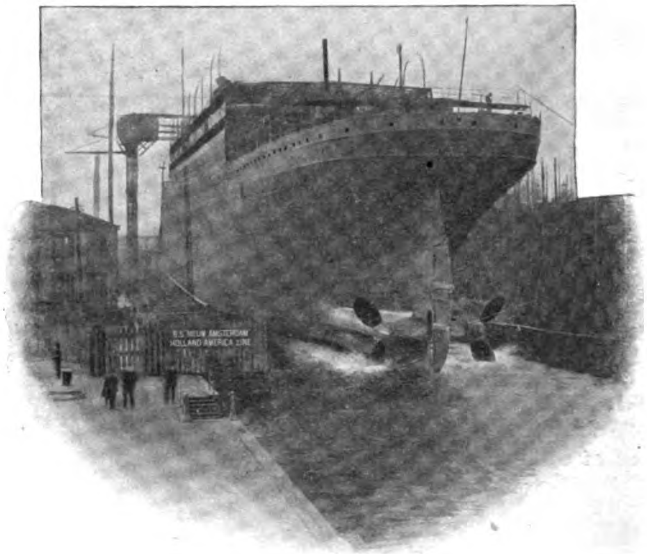
inasmuch as, on her upper deck, she will be provided with a certain number of so-called tandem cabins, a novelty on the Atlantic, by which the drawback of the inside cabin is entirely overcome.



AN UNUSUAL WIDTH OF PROMENADE DECK.

The cabins on the bridge deck are exceptionally large; on this deck suites of "cabin de luxe," consisting of drawing room, bedroom, with brass bedstead and private bathroom, have been provided. Numerous bathrooms are found in judicious locations all over the steamship.

The main saloon, on the saloon deck, is luxuriously furnished in every detail. In addition to numerous windows, a large magnificent dome, with cupola of decorated glass, gives perfect ventilation and light. Ascending the main staircase of the vestibule, the latter leads forward to the social hall, an exceedingly spacious room, sumptuously furnished in empire style, and amply pro-



LAUNCHING OF THE NEW AMSTERDAM.

vided with sofas, fauteuils, a grand piano, bookcase containing a choice selection of literary works, and a number of small writing desks.

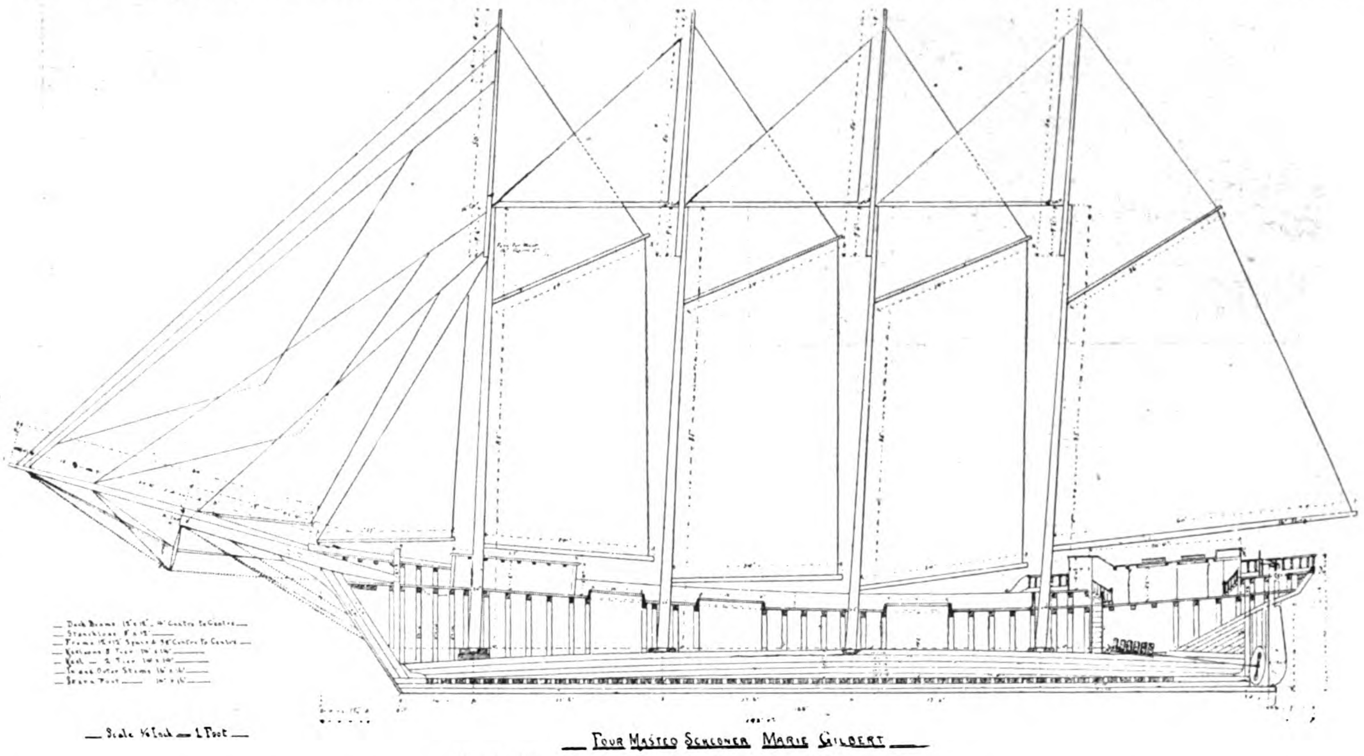
Another novelty will be the so-called "Ladies' Tea-Room," in Japanese style, for which the panels have been specially ordered from Japan. It is expected that this room will be as popular with the ladies as the smoke-room is usually with the gentlemen. This latter room (with bar annexed) is finished in antique oak and connects with the promenade deck as well as the deck below. This room is exceptionally large and commodious, and elaborately decorated in Dutch style with faience tiles of the famous Dutch art potteries, representing various

views of New Amsterdam at the time of the first Dutch settlements.

The promenade deck offers a walking space of 8,200 sq. ft., the promenade alongside the deckhouse of the bridge deck a space of 4,440 sq. ft., and the so-called boat deck, constructed above the promenade deck proper, a space of 5,000 sq. ft., making over 17,000 sq. ft. of walking space set apart for the passengers. Only very few steamers crossing the Atlantic will equal the S. S. New Amsterdam in this respect.

An information bureau, centrally located on the bridge deck will prove a great convenience to passengers, who will be able to get there general information, receive letters and telegrams, and leave the keys of their staterooms, in the same manner as this is done in a first-class hotel. Another new department is the safe deposit with which the steamer will be provided, and where passengers will be able to deposit their valuables, jewelry, etc., keeping themselves the key to the locker they have taken.

The second-cabin staterooms, for the accommodation of 250 passengers, are situated on the upper deck, aft of the first-cabin staterooms, and are finished in the same style. The large second-class dining-saloon, built over the entire width of the steamer on the same deck on which the first-class dining-saloon is situated, is elegantly furnished, and has a beautiful dome with cupola of decorated glass. The second-cabin ladies' saloon and smoke-room are situated on the deck above; these rooms are most artistically appointed and finished in light-colored hardwood, with inlaid decorations. Separate and spacious promenade decks for second-cabin passengers give ample opportunity for exercises and deck games. Like all other steamers of the Holland-America line, S. S. New Amsterdam has been fitted with Marconi's system of wireless telegraphy.



PLAN OF AUXILIARY SCHOONER MARIE GILBERT.

## AUXILIARY SCHOONER MARY GILBERT.

The four-masted schooner Marie Gilbert was launched on Saturday, April 28, from the yard of the Gilbert Transportation Co., Mystic, Conn. She is interesting in that she is to be equipped with a 150-H. P. Hasbrouck motor turning a three-bladed propeller for use in calm weather. The vessel is 185 ft. long, 36 ft. wide and 13 ft. deep. The gasoline will be carried on deck in large tanks just forward of the after deck house. Tanks and pipes leading to the hold will be water jacketed, therefore giving protection from leakage. There is a large sky light 6 x 10 ft. on top of the after house which throws light down into the engine room. The engine will be set on the keelsons underneath the cabin floor. The engine room will be 6 ft. wide and about 14 ft. long. It is entered from the forward cabin and the steps are practically underneath the sky light. The Gilbert is a vessel of extra light draught, and will draw only 13 ft. of water when loaded with 500,000 ft. of hard pine lumber, or 1,000 tons of coal. The vessel will be lighted throughout with electric light. She will have a 24-H. P. engine forward, for handling cargo, hoisting sails, pumping, heaving up anchor, and all other heavy labor. She will carry a crew of eight men, all told. Her speed will be about six knots an hour in calm weather. She has been designed from the best models, and the material and workmanship in her are the very best obtainable.

The Gilbert has already been chartered for a number of years in advance by one company to bring lumber from southern lumber ports to Norwich, Conn. The company expects to build another vessel of the same kind as the Marie Gilbert during the coming year.

The present fleet handled by the Gilbert Transportation Co., consists of the following vessels: Catherine M. Monahan, 871 tons; Elizabeth T. Doyle, 774 tons; Winifred A. Foran, 818 tons; Glad Tidings, 654 tons; Belle O'Neil, 467 tons; John R. Bergen, 647 tons; Fortuna, 612 tons; Wm. L. Walker, 591 tons; and Marie Gilbert, 600 tons. The company's main offices are located at Mystic, Ct. The officers are M. L. Gilbert, president; Chas. H. Hanscom, vice president, and George E. Gillchrest, secretary.

The fastest voyage yet made by a vessel of the Great Northern Steamship line between Seattle and the Orient was accomplished recently when the steamship Minnesota arrived at Seattle 13 days and 16 hours out from Yokohama.

## THE SALVAGE OF SHIPS.*

BY FRED W. YOUNG, M. I. MECH. E.

There is something about marine salvage work that has always appealed to the adventurous spirit of the Briton, particularly those who go down to the sea in ships, and generally to the whole of the shipping community. The people of our nation are admittedly good sportsmen, and the speculative nature of the work in which great risks are sometimes run in order to save something that looks as if it were lost, appeals strongly to those sporting instincts. By risks, the author does not mean the actual personal risks to the people employed at the work, but the risk of expending large sums of money with the chance of losing it, as well as the object it is intended to try to save. There is a good deal of the same spirit of adventure about the work which induced our forefathers to equip expeditions, and make voyages to unknown seas in their search for hidden treasure.

FIG. 1.—STEAMER ASHORE ON WEST COAST OF AFRICA.

One particular feature of salvage work which, although sometimes very disappointing, is always interesting, is the difficulty of mapping out a plan of operations and carrying it through as originally intended. There are so many factors working against the salvage engineer, such as weather and other contingencies, that however well he plans and thinks out a certain course of procedure, something will surely happen in most cases that will upset his calculations to a more or less extent. It is nearly always a fight against the weather, and it has become an axiom with the salvage engineer that he should be able to quickly determine what to leave alone.

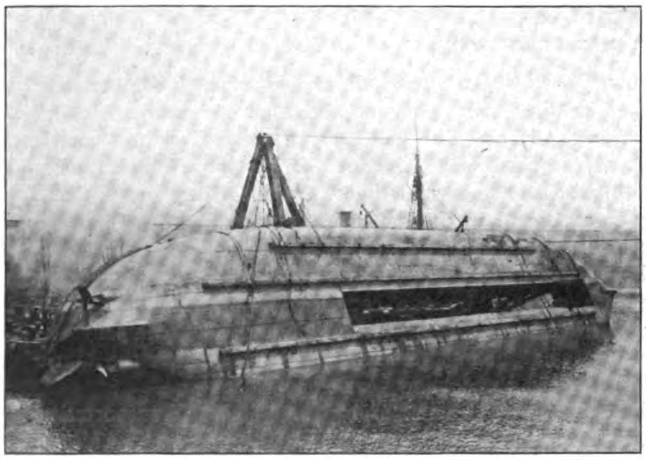


FIG. 2.—STEAMER WALTER BIBBY; COMMENCEMENT OF THE TURNING OPERATIONS.

*Paper read before the Liverpool Engineering Society.

The commercial aspect must always enter into any calculations he may make, and the method adopted must necessarily be regulated by the value of the article to be saved. The modern salvor is thus faced with two important considerations: he must regulate his expenditure within these bounds, and decide on the spot whether the cost of his plan of operations will be repaid by the results he can reasonably hope to achieve. There is still always the risk remaining that the wrecked vessel may receive more damage after the operations are commenced, on account of inclement weather coming on, or other untoward circumstances intervening, and in some instances, although the ship may be still salvable, the damage may be so extensive that the repairs will cost more than she is worth. The principle of constructive total loss must be the dominating factor in his calculations and guide all his operations; which principle, as you are aware, means that the cost of salvage, plus re-instatement, must always be less than the market value of the recovered ship when repaired.

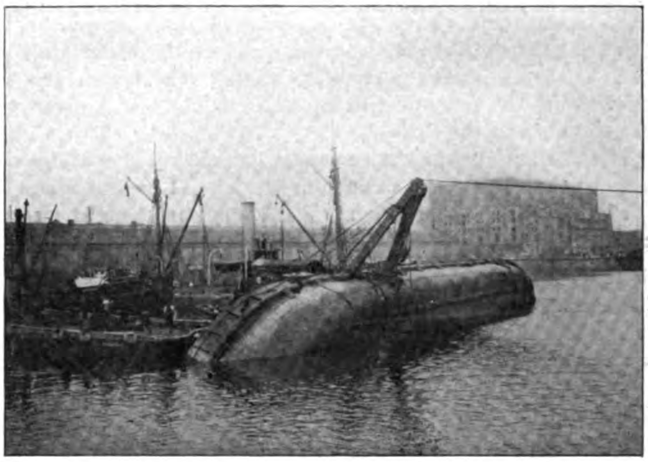


FIG. 3.—WALTER BIBBY TURNING OVER.

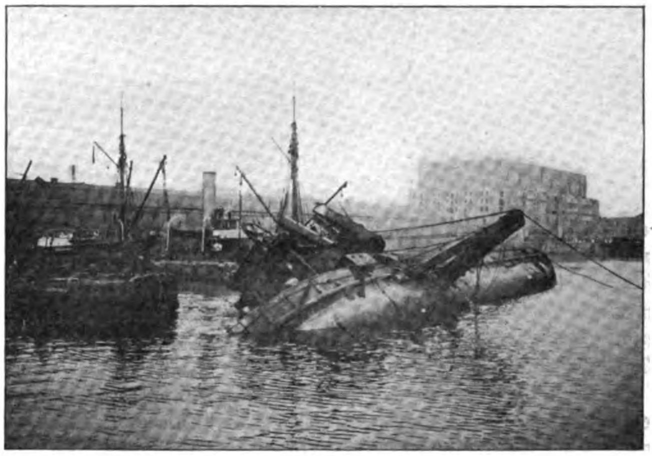


FIG. 4.—WALTER BIBBY TURNING OVER.

Taken as a most important branch of the science of engineering, marine salvage work has not received the attention it really deserves. Until of late years very little improvement had been made in the necessary plant and appliances over what had been in existence for many years previous, and it may safely be asserted that twenty years ago no thoroughly equipped salvage steamer existed in Great Britain. At that time, Liverpool possessed in the Hyæna, one small, but very useful vessel, and there were a few others in the country, but certainly nothing worthy of the greatest maritime nation of the world. It is true that considerable progress has been made during that period, but it is a regrettable fact that that progress has not been in any way commensurate

with the advances that have been made in almost every other branch of the engineering profession, and as a natural consequence the foreigner has entered the market, and his salvage steamers may now be found stationed at a number of places that have hitherto been neglected by the British salvor.

The present methods of floating wrecked vessels may be summed up under a few heads, viz.—patching and pumping,

FIG. 5.—WALTER BIBBY UPRIGHTED.

coffer-damming or building up the bulwarks to above the water line where the depth is too great to pump out, and lifting by means of pontoons attached to wire ropes placed under the sunken vessel, when the depth is too great to allow of coffer-damming.

Taking first, "patching and pumping." This method is adopted where a vessel has gone ashore on rocks or sand and holed herself, more or less badly, sometimes filling up all the compartments with water which ebbs and flows with the tide. The most arduous part of this work, in most cases, falls to the divers, whose duty it is to make the fractures as watertight as possible. An examination is first made of the bottom, and plans for patching up the holes arranged; anchors are laid out to keep the vessel in position and assist in heaving off; and, if the ship is in an exposed place, scuttles are cut in the hull to admit water in order to keep the

FIG. 6.—S. S. SARAH BROUGH SUNK IN 12½ FATHOMS OFF HOLYHEAD.

vessel quiet in the event of bad weather coming on. The necessary number of steam pumps are put on board, and when everything is ready and a favorable opportunity occurs, the ship is pumped out and floated. Time will not permit of going more fully into all the details, but a view illustrative of this method will now be shown.

Fig. 1 is a view of a vessel ashore on the west coast of Africa. The operations were similar to those described, and the vessel was floated. The bottom was very badly damaged, and the principal difficulty in the case was to temporarily repair this damage so as to enable the ship to make the long voyage to England in the winter months, there being no graving dock available, and no place where she could be satisfactorily beached to enable the work to be done.

The difficulties, however, were overcome, and the steamer arrived safely at an English repairing port.

With reference to the cutting of scuttle holes in a vessel in this position, in order to let water in to keep her quiet should bad weather come on, it is necessary to have some method of controlling the water, but at the present moment the author does not know of any satisfactory way of doing this. That is to say, that after scuttle holes are cut, say of 10 inches diameter in the hull of a stranded vessel, probably at the turn of the bilge, no satisfactory portable valve has yet been invented that can be attached easily to these holes

FIG. 7.—PONTOONS LIFTING THE SARAH BROUGH.

and opened or closed from the deck at will, as the tide or sea covers them.

Several kinds have been used and experimented with, but none of them has been quite satisfactory. Rods from the outside of the ship, attached to the valves or ports, and manipulated by screw gear from the deck have been tried, but owing to the length and necessary lightness of these rods or controlling gear they are liable to damage by bending through a sea striking them, and so rendering them unworkable. It frequently happens that owing to the holds being partially full of coal, or other cargo, it is impossible to get down inside the vessel to attach anything there.

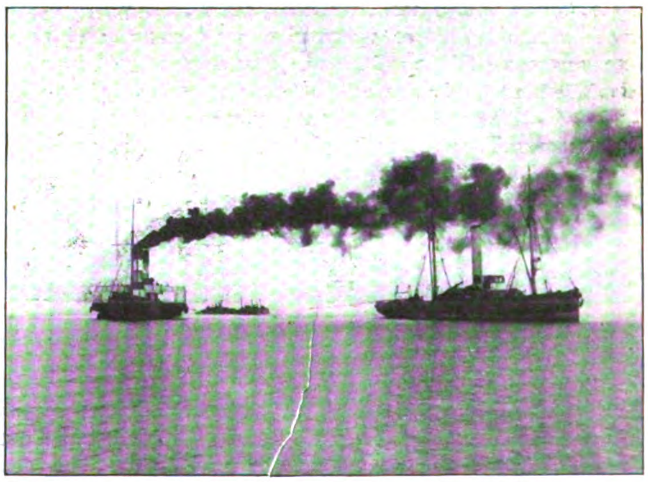


FIG. 8.—S. S. SARAH BROUGH BEING TOWED TO CEMAES CARRIED ON THE PONTOONS.

The next view gives an example of a bad fracture. This was 10 ft. wide, and 17 ft. deep, and you will notice the plating is turned and projected outwards, in some parts as much as 6 ft. In order to make up this fracture, it was necessary to first completely cut away the outwardly projecting plates. The upper portion of this work was performed with pneumatic tools, worked from a compressor on board the salvage steamer, and the lower portion was cut away by dynamite, placed in position by the divers, and fired by wires attached to the dynamo of the salvage steamer. When this

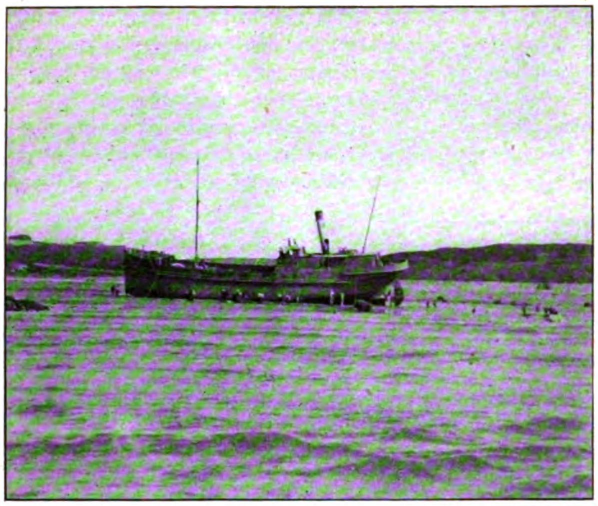


FIG. 9.—SARAH BROUGH BEACHED AT CEMAES.

was completed the hole was planked up and made comparatively watertight also by the divers, and the next view will show the work done by them under water. This view was taken in dry dock, after the vessel's arrival in Liverpool.

The closing up of the hole was commenced from the bottom of the fracture upwards. Pitch-pine planks, 4½ in. by 12 in., were used and secured by bolts, having a hook on the inner end, which was hooked on to the sides of the fracture. The planks were put on one at a time, and the seams were caulked, covered with canvas and battened, and the patch stiffened vertically by steel plates, 12 in. wide by 6 ft. long by ⅜ in. spiked to the woodwork. As the water was pumped

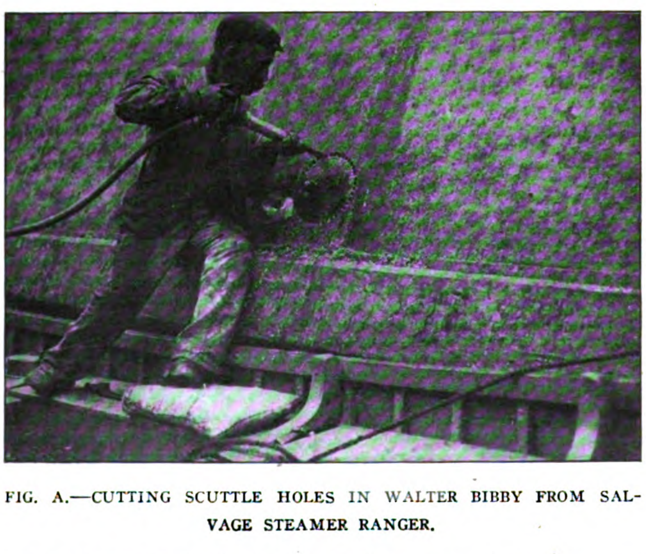


FIG. A.—CUTTING SCUTTLE HOLES IN WALTER BIBBY FROM SALVAGE STEAMER RANGER.

out of the hold the hooks of the bolts were further secured from the inside, and the patch shoved off against the outward pressure. It was practically watertight. The next method is the cofferdam. This is adopted when the vessel is sunk in water too deep to allow of closing up the hatchways and other openings and then pumping out, as the decks would not be able to stand the pressure of the weight of water above them.

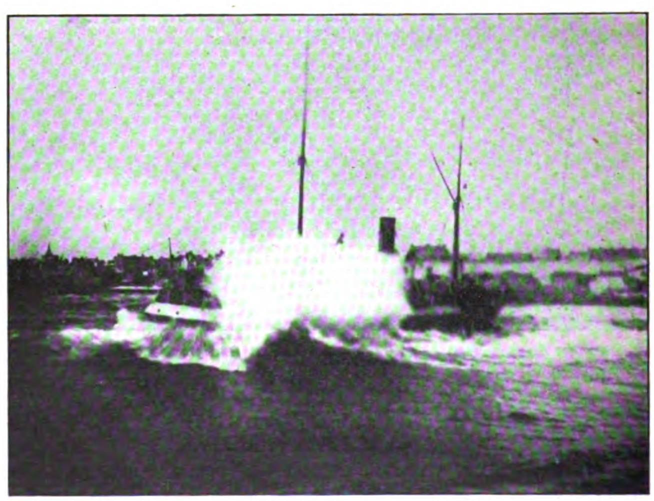
The bulwarks are built up by the divers to above the water level, and the vessel is then pumped out by the salvage steamer's pumps. It has been successfully accomplished in a number of cases, particularly in the case of the Utopia, sunk near Gibraltar. The plan, however, is not applicable in very exposed positions.

When the depth of water over the sunken vessel exceeds the limit of the cofferdam, the ship has to be lifted by pontoons. British salvors are lamentably deficient in appliances of this description for heavy lifts, and in the case of a large vessel being sunk in deep water, even in our own river, there are no suitable pontoons to lift her. While appliances were being improvised, the vessel would probably be receiving further damage and possibly obstructing the navigation. This method will be illustrated later by a description and views of the raising of a small steamer sunk off the West Mouse, near Holyhead, in 12½ fathoms at low water springs.

The next example is the interesting case of the uprighting and subsequent floating of the capsized dredger Walter Bibby, in the Queen's Dock, Liverpool. The Walter Bibby is

FIG. B.—CUTTING SCUTTLE HOLES WITH PNEUMATIC TOOLS FROM THE RANGER.

a twin screw dredger of the center ladder type, discharging at either side at will. Her dimensions are: 180 ft. long, beam 40 ft. 6 in., and depth of hold 10 ft. The vessel is capable of dredging to a depth of 45 ft. below the water line, and can raise 600 to 700 tons per hour. The ladder has 38



SEAS BREAKING OVER A STRANDED STEAMER.

buckets each weighing 25 cwts.; the links connecting the buckets weighed 5 cwts. each. The author wishes to call your

attention to these pins and links, as later on he will give you an illustration of the power and peculiarities of high explosives when used for the purpose of cutting heavy masses of metal adrift under water.

The dredger is fitted with compound surface condensing engine, with cylinders of 25 in. and 51 in. diameter, and a stroke of 3 ft. She has two boilers, 12 ft. diameter by 10 ft. long, and is also fitted with independent engines for driving her deck machinery fore and aft the vessel.

As far as could be estimated the entire weight of the vessel was about 1,150 tons; the bucket ladder alone weighing between 60 and 70 tons. At the time of the accident she was chartered by Messrs. Pearson & Sons, the contractors for the new Queen's graving dock, etc., and was engaged in dredging and removing the wall of the old Queen's dock. This was a very difficult operation, and during its performance it is supposed that one of the buckets took up a larger piece of granite than could pass through the center well, which in its passage upwards pierced the side of the port buoyancy chamber and allowed the water to rush in. The vessel having a heavy list at the time lost her equilibrium, and capsizing completely over to port, was only prevented from turning bottom upwards by the top part of the ladder or superstructure becoming embedded in the mud and sandstone rock at the bottom of the dock. She was then lying past her beam ends and at an angle of 113 degrees.

Divers were sent down to examine and they reported her lying hard down on the rock on her port side, clear of the wall she was dredging, about 15 ft. The buckets had fallen off the rollers when the vessel capsized, and were lying in a bunch at the bottom of the dock. Two plans of uprighting suggested themselves. The first was to close up all the lee hatches and other openings, and place the necessary number of steam pumps in craft alongside, then pumping out the lee buoyancy compartments and attaching counterpoise weights to the higher side, turn the vessel over by these means. The principal objection to this scheme was the amount of carpenter's work that would require to be done under water; but besides there were numerous other difficulties. The second, or alternative plan, was to parbuckle the vessel up by means of wire hawsers and lifting pontoons. This last plan was finally decided upon, and it then became necessary to approximately estimate the amount of power required to carry out this operation. After some calculations, which it is not the author's intention to trouble you with, it was decided that there was sufficient plant available to enable the work to be carried out in the last named manner, and a commencement was made.

The first difficulty encountered was the getting rid of the buckets which were lying at the bottom of the dock, and the following expedient was adopted:

The bight or center of the chain of buckets was slung by the divers, and the 30 and 40-ton derricks of the Ranger and Linnet attached; the buckets were then hove up nearly to the surface of the water, but owing to the manner in which they were jammed it was found impossible to disconnect the pins and so release them. They were then lowered down again to the bottom of the dock and were eventually separated by explosives.

On account of the close proximity of the vessel to the new dock walls it was dangerous to use heavy charges, and at the first attempt to sever the bucket chain only two pounds of gelignite was used, but owing to the heavy section of the wrought iron double links, which measured 8½ in. by 4½ in., this charge had no effect whatever, so it was doubled and a charge of four pounds then exploded. This proved perfectly successful. It is a curious fact, illustrative of the power of high explosives, that the charge was placed on the lower link and it not only severed this completely, but also cut the upper link through in the same manner, although it was not directly in contact with it. The operation was repeated as necessary, and the chain of buckets cut apart in sections of 3 or 4. They were then raised from the dock bottom by the salvage steamers.

The author has no photograph showing the cut, but the next slide gives a view of some of the buckets after they were landed on the quay. The remainder of the chain of buckets, after being freed from the dredger, were dropped to the bottom of the dock and subsequently raised by the 100-ton crane Atlas.

The problem that next presented itself was how to secure standing part of the parbuckling wires. There was nothing on the higher side of the deck of the dredger in the shape of bitts capable of bearing the strain, and it was eventually decided to fit strops made of a double part of 6-inch wire rope, round the keelson in the upper compartment, taking the ends through the hatchways and openings in the deck, and shackling them on by means of specially constructed shackles to the standing parts of the 9-in. parbuckling wires.

Four of these were used and were hove under the ship by the salvage steamers Ranger and Linnet. Owing to the way the vessel was resting on the rock much difficulty was experienced in getting these wires under her, the two steamers having to tow alternately at their utmost speed, thereby cutting, or rather sawing the sandstone rock away until the wires were in their required position. Sheerlegs were constructed on shore, composed of pitchpine logs 24 in. square, made in the form of a tripod, with a heavy casting on top to take the wire rope. These sheer legs were 25 ft. high, and weighed about 12 tons. After being erected on shore they were lifted from the quay by the Ranger and secured on the high side of the vessel as shown on the accompanying view. The end of a 9-inch wire rope was then secured by the divers to the extreme end of the dredging towers lying in the bottom of the dock, and taken over the casting on the top of sheerlegs to the quay wall. A 100-ton purchase was attached to this wire, and a steam winch with 9-in. cylinders, 12-in. stroke, secured to the concrete on the dock wall, and supplied with steam from a portable boiler working at a pressure of 80 lbs. per square inch. From the end of the crane used for lifting the bucket ladder on the fore part of the vessel another 9-in. wire was attached by the divers, and the end taken to a 75-ton purchase on the dock wall, worked by another winch of the same power in a similar manner, and supplied with steam from a similar boiler. Two 6-in. wire ropes were then made fast to the immersed lower bulwarks of the vessel by the divers, and the ends carried across to the opposite side of the dock, where they were secured. These were intended as check ropes in case the dredger, on uprighting, showed any tendency to fall over the other way, and they had slack enough to allow her being uprighted.

The upper or starboard buoyancy spaces being empty and clear of the water, would have offered a very considerable resistance to the righting operations when the vessel had been sufficiently turned for the lower part or bottom of these compartments to become effective as the operation brought them into the water, and it became necessary to devise some plan by which water could be quickly admitted into these compartments at the proper moment to destroy their buoyancy. It was decided to cut holes through the bottom of the vessel, and as these holes would be resting on the flat rock when the ship was upright, and would have to be closed by the divers before she could be pumped out and floated, a plan had also to be schemed out so that they could be closed up readily from the inside, and the following method was adopted:

The two large buoyancy compartments had hatchways sufficiently large for a diver to get through to the bottom of the ship, and immediately under these hatchways two holes of 10 inches in diameter were cut through the shell plating

with the Ranger's pneumatic tools, as shown in the two photographs. Also, two pieces of copper piping, 10 inches long, fitted with suitable external flanges, were made and inserted through the holes from the outside, the flanges being bolted on to the shell plating. The inner end of the tubes were fitted with a hinged lid which could be easily closed by the divers under water. This plan proved quite successful, and when the time came to pump the vessel out they were closed up tightly in a few minutes.

All being now in readiness, the Mersey Docks and Harbor Board pontoons, Enterprise, Octopus, and Adventure, were made fast to the outer ends of the parbuckling wires, bows on, and the Liverpool Salvage Association's steamer Linnet to the forward parbuckling wire. The latter vessel not being fitted for lifting work, a greenheart log 14 in. square was passed through her bow ports from side to side, and the end of the wire made fast round this.

In order to obtain the life of water sufficient to upright the vessel it was necessary to lower the water in the dock from 22 ft. down to 9 ft., which necessitated the lowering of the water in three other docks. This was a very big undertaking, involving, as it did, the removal of numerous steamers, with the consequent interference in the loading and discharging of their cargoes. To limit the inconvenience as much as possible, it was arranged that the work should start on Saturday evening, so as to give the whole of Sunday to the righting operations.

This was done, and on Sunday morning all the lifting vessels were pinned down as shown in the view, the shore purchases hove taut and the water allowed to gradually enter the dock. In the course of these operations one of the lifting pontoons pinned dangerously, and being nearly on her beam ends, it became necessary to slip her. When she was released a heavier strain was consequently brought upon the other lifting vessels, but principally on the shore purchases, which resulted in one of the heavy bollards (to which was fastened the 100-ton purchase) being dragged from its concrete foundation, involving some little delay until it could be again secured, when everything was hove taut again, and the vessel gradually turned over.

Figs. 2, 3, 4 and 5 are interesting series of photographs which were taken during the time the dredger was in the act of turning over. The first shows everything ready, all the lifting vessels pinned down and the shore purchases hove taut. In this one, you will notice the vessel has gone over a little, and the strain on the tripod is very considerable owing to the altered angle of the lead.

In the next view the lifting vessels have been slipped to prevent them being holed as the dredger came up underneath them—the shore purchases are now slack, and the vessel rapidly filling through the holes cut in the bottom, as previously described. The violent ebullition on the surface of the water, of course, indicates the escape of air which has hitherto been confined in some of the compartments.

The succeeding view shows the dredger nearly uprighted, but on the dock bottom, and lying with 15 ft. of water above her decks.

On the following Saturday, the fractures having been made tight by the divers, the water was again lowered in the dock. Five steam pumps were placed on the craft lying alongside, the suction hoses placed in the different compartments of the dredger, bulwarks and deck fractures secured, the vessel pumped out and floated.

Referring to the method of lifting by pontoons, a description will now be given of the operations which took place at the wreck of the steamer Sarah Brough.

The recovery of this vessel is a specimen of actual lifting, that is to say, an actual lift from the bottom of the sea, from 12½ fathoms at low water spring tides, in one of the strongest tides on the coast of this kingdom. There are extremely few cases of the recovery of a vessel sunk out in the open sea, and this ship enjoys the reputation of being one of the few of its kind recovered under similar conditions.

The Sarah Brough (Fig. 6) is a small steamer of 300 tons, and her dimensions are 132 ft. by 23 ft. by 10 ft. 7 in.

While on a voyage to Dublin she struck the Skerries Rocks off Holyhead, and sunk off the West Mouse in 12½ fathoms of water at low water spring tides. She was lying in the full strength of the tide, the top of her masts only showing as you will see in the view. The divers had much difficulty in making an examination of the vessel on account of the tide, but they reported her on shingle, upright and slightly scoured away at each end under the bottom, which would make it easier to get the lifting wires under.

The salvage steamer Hyæna was anchored on the port side and a small chain taken from her by the Ranger and swept under the after end of the ship. When this was towed under far enough a 9-in. wire was attached and hove under to the required position, and the operation continued in the same manner until four wires were in place, each wire capable of standing a strain of 280 tons. To this the two pontoons, Enterprise and Adventure, belonging to the Mersey Docks and Harbor Board, were attached at low water, and the wires hove taut. On this tide the vessel was moved about a mile further inshore. The tide here, although not quite so strong as near the Mouse, was very considerable and made the work still difficult for the divers.

It was therefore decided on the next lift to try and carry the ship out into the deep water of the channel and along the coast, about five miles, in order to get into Cemaes Bay, where she would be out of the strength of the tide. The usual method of carrying a vessel in the wires is to make the tug boats fast to the pontoons and put them end on to the tide, allowing all the craft to drop up together with the current, so that the tug boats shall have command of the wreck and check her quickly in the event of touching a pinnacle of rock. As it happened in this case the lifting vessel did not get the weight until just before high water, and if she had been dropped up it would have taken so much time on the falling tide that there would not have been sufficient water for her to enter Cemaes Bay. (Fig. 7). On the other hand, to tow up with the tide would be a very risky proceeding, as in the event of a rock being in the way, say 10 or 12 ft. clear of the bottom, and the wreck should touch, all the lifting wires would be carried away and probably a great deal of other damage done; perhaps resulting in the total loss of the ship. However, as time was of the utmost importance, and it was necessary to get the vessel out of the open into a place of comparative safety in the shortest possible time, it was decided to take the risk; but, in order to minimise that risk as much as possible, very careful soundings were taken by the Ranger all along the channel and only the men who were absolutely necessary were left on board the pontoons. The weather fortunately was very fine and the slack of the wires having been taken in evenly, the pontoons floated in good position and were taken in tow by the tugs. Everything happily went well and the wreck was towed along the five miles with the current at a very rapid rate, some part of the journey being in as much as 20 fathoms of water.

She was grounded in Cemaes Bay, (Fig. 8) well out of the strength of the tide, and the worst part of the work was then over. It, however, took four more lifts to place the vessel where her decks were dry at low water, and she was then pumped out by the Ranger, floated and towed up the beach, where she dried altogether at low water. The damage to the bottom was subsequently patched up and the vessel towed to Liverpool by the Ranger.

This concludes the operations at this steamer, and is given a specimen of the manner in which ships may be lifted

from great depths. The actual weight lifted in this case was about 370 tons.

The author has been unable, owing to the time it would take, to go into all the minor details of the case, but before closing his remarks would like to say that there is room for very much improvement in this class of work. For instance, we have, at present, no means of knowing exactly the strain that each wire rope is carrying. The slack of each of the wires is taken in at low water as carefully and uniformly as possible, but even then one may be tighter than the other, and as this wire will get the strain first it may easily be carrying more weight than its safe load, and should a rupture take place the consequences may be very disastrous.

All lifting vessels should be fitted with compressors through which the wire ropes would pass, and these compressors should be of sufficient strength to enable any of the ropes to be slacked away to an inch if necessary, even when bearing their full weight of 280 tons.

Apparently the demand in the former case could be met by attaching some sort of dynamometer to the lifting wires, so that the exact strain in tons the wire is bearing at any particular moment can be seen at a glance, so enabling them to be slacked away until each one has an equal strain. It is possible such an apparatus is already in existence, but if so, it has not come under the author's notice, at any rate in a form convenient enough to make it available for salvage work. There are many other appliances and requirements which are well worth the attention of the engineer and the inventor, but which the author regrets time does not permit him to enumerate or describe, and he will therefore close by thanking you for the kind attention you have given him.

## THE STEAMER DAVID Z. NORTON.

Capt. W. C. Richardson is quite convinced that in the David Z. Norton he has the best freighter on the lakes. She is a 500-footer and can carry about 8,200 tons of ore on 19-ft. draught. She differs from the prevailing type of lake vessel, in that her hatches, of which she has only fourteen, are 12 ft. fore and aft. This makes an unusually wide opening and enables the clam shell to work well under the deck. At the same time this permits a rigidity of construction that is not possible in the 12-ft. center vessel.

To begin with, there is 12 ft. of deck space between each hatch, and in addition to the arches, of which there are fifteen in the Norton, and which are usually the sole strengthening of the sides and deck in a 12-ft. center ship, there are fifty-six deck beams each 52 ft. long, 3 in. thick and 12 in. deep. The arches weigh 8 tons each and are 5¼ ft. deep. There has been so much steel worked into the ship that Capt. Richardson believes her to be at least 400 tons heavier than a 12-ft. center ship of the same length. There are three such vessels on the lakes now, the Eugene Zimmerman, W. H. Bixby, and the D. Z. Norton. The two steamers building for the Cambria Steel Co. are to be of similar construction. The only vessel of this type that has both loaded and unloaded cargo is the Bixby, as the Zimmerman collided with the Saxona on her maiden trip and is still aground. The merit of this type of ship, in Capt. Richardson's eyes lies in the fact that it can be both loaded and unloaded from every hatch simultaneously and requires no trimming.

It is, however, in numberless well-thought out little details that the Norton presents advantages over other freighters. These details are entirely the work of Capt. Richardson and are the result of the experience of a lifetime. For instance, the mates' pump, instead of being stowed away in some dark corner under the forecastle deck, is installed in the engine room immediately under the engineer's eye. When the mate wants water for flushing the decks, he has but to telephone to the engine room and the pump goes immediately into commission. The hinges on the skylight over the engine room are of solid brass, as iron ones rust out within a year or two. There are three Brosseau engines installed forward, amidships and aft respectively, for operating the hatch covers. The hatch covers are further strengthened by thwartship strongbacks fore and aft 20 in. from coaming. A deck engine has also been installed amidships for warping the steamer along the dock should occasion require to move her. The bulwarks at the eyes of the ship are 4 ft. 8 in. high and have a fine sheer and slant to 2 ft. 10 in. at the aft end of the forecastle deck, which is 50 ft. long. There are three wrecking wells, one forward, one aft and one amidships, so that in case of emergency access can be got to any part of the ship. The sides of the cargo hold are 4 ft. 6 in. from the skin of the ship, and the water bottom is 5 ft. deep. Water ballast is carried, not only in the water bottom, but along the sides of ship as well, the vessel having a water ballast capacity of over 5,000 tons. A space of 24 ft. separates the collision bulkhead from the screen or second collision bulkhead, which is 14 ft. forward from the first hatch. The cargo hold is divided into three compartments by two bulkheads. In the construction of these bulkheads, Capt. Richardson's experience is again in evidence. The stringers are up and down, instead of athwartships. The reason for this is sensible and clear. Ore will lodge on an athwartship stringer but will slide harmlessly down a perpendicular one like water on the bark of a tree. There are fifteen of these stringers in each bulkhead.

Much thoughtfulness has been displayed by Capt Richardson in the crew's accommodations. The galley is a model of convenience and is fitted with every appliance for facilitating work. One of the ingenious arrangements is the partition which separates the kitchen from the pantry. It is so constructed that dishes put in from the kitchen end are accessible from the pantry compartment, thus obviating the necessity of the waiters entering the kitchen in order to get clean dishes. In the dining room is a fine Chelsea clock, presented to the ship by Mr. David Z. Norton. This clock is manufactured by the Chelsea Clock Co., Boston, Mass.

"Have three of them on the ship," said Capt. Richardson, "wouldn't have any other. One of them hasn't varied a minute in four years and hasn't required any attention in that time either."

Accommodations are provided aft for the engineers, the firemen, oilers and water tenders. The rooms are spacious and shower baths are provided for all. Fresh water is provided for this end of the boat by four water tanks, each 12 ft. long and 3 ft. in diameter, carrying sufficient water to last 60 days if necessary.

The space forward is equally divided between accommodations for passengers and crew. On one side of a wide corridor, which is entered by a 4-ft. door, are the passenger quarters; on the other side are the quarters for mates, wheelmen and watchmen.

"Why did I make that door four feet wide?" said Capt. Richardson. "I will show you in a minute."

"This corridor leads directly into the windlass room abaft the collision bulkhead.

"If anything happens to a windlass on any freighter on the lakes, they have to take the forecastle deck off to get at it," said Capt. Richardson. "In this case it can be taken along the corridor and out of the 4-ft. door without disturbing anyone. That's why I made that door four feet wide."

The captain's quarters are all that thoughtfulness and experience could provide. He is in complete communication with all parts of the ship by telephone, there being seven telephones in all aboard. For his personal comfort accommodations are provided that are not equaled in any hotel.

THE MARINE REVIEW

DEVOTED TO EVERYTHING AND EVERY INTEREST CONNECTED OR ASSOCIATED WITH MARINE MATTERS ON THE FACE OF THE EARTH.

Published every Thursday by

The Penton Publishing Company

CLEVELAND.

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|---|---|
| CHICAGO: | MONADNOCK BUILDING. |
| PITTSBURG: | PARK BUILDING. |
| NEW YORK: | 150 NASSAU STREET. |

*Correspondence on Marine Engineering, Ship Building and Shipping Subjects Solicited.*

Subscription, $3.00 per annum. To Foreign Countries, $4.50. Subscribers can have addresses changed at will.

Change of advertising copy must reach this office on Thursday preceding date of publication.

The Cleveland News Co. will supply the trade with the MARINE REVIEW through the regular channels of the American News Co.

European Agents, The International News Company, Breams Building, Chancery Lane, London, E. C. England.

Entered at the Post Office at Cleveland, Ohio, as Second Class Matter.

MAY 3, 1906.

## THE STRIKE ON THE LAKES.

There is no class of labor in the world so well treated as that which is associated with the commerce of the great lakes. Not alone is it well treated in respect to wages, but also in that which makes for comfort and convenience in work. Naturally this condition was not brought about in a day. It has been the gradual growth of nearly half a century, but is notably the development of the past decade. The captains of industry along the chain of great lakes are in no sense labor crushers. In nearly every instance they are men who have come up from the ranks. They have been intimately associated with labor all their lives. Indeed, the betterment of conditions all along the line is their handiwork, for they learned through personal experience the ills to be remedied. There isn't any nicer work of a physical kind to be had than that aboard the average lake freighter. The pay is good; the food excellent and abundant; the privileges many; and as for personal comfort, the average hotel certainly does not afford as much. Commodious rooms and shower baths are provided for all. Stoking may be hot and killing work on an ocean liner, but the fire-room of a modern lake freighter is about the coolest and best ventilated room on the boat. As an evidence of this, deck hands have already signified their willingness in certain instances to take the places of the firemen that have been called off in the present strike of the longshoremen.

The bulk freight business of the great lakes has enjoyed during the past few years a fair state of prosperity. This is not saying that dividends have been large, because they have not, but the volume of freight moved has been enormous and employment has been steady. Labor has had its share. The scale of wages has been a steadily ascending one. Wages have been paid regularly and everyone in the great lakes region has enjoyed the blessings that come from continued employment. It does seem a pity that this state of things should be halted for no sound reason and a strike declared which has paralyzed industry along a thousand miles of waterway, compelling an extended and varied equipment of ships, railways and terminals to cease operating and throwing thousands of men out of employment. The ships, railways and docks can stand it, because the trade must eventually come back to them. The ore is there and the railways, ships and docks will sooner or later handle it. But can the workmen stand it? The wages that they lose are lost forever. President Keefe of the longshoremen's association, projected this strike because he would not make an agreement with the dock managers for unloading cargoes until the Lake Carriers' Association had recognized the mates' union. The dock managers have nothing whatever to do with labor aboard ship, and felt that they were powerless in the premises. Moreover, it should be understood that the mates had already signed with the masters for the season and that practically all the mates in active service were members of no union whatever. It is doubtful if any mates' union exists at all. This move appears to have been projected to force the mates into a union. It is meeting with little success, however, as practically all the mates are standing by their ships. During the first day a few mates, probably eight, quit along the whole chain of lakes, but by the second morning five of them asked to be reinstated. Frankly speaking, President Keefe, hitherto extremely conservative and a conspicuous success as a labor leader, appears to have made a serious blunder. The present strike deserves to fail on moral grounds.

Rothwell & Co. have organized a company known as the Venice of America Land Co., with offices at 501 and 502 Chamber of Commerce, Detroit, for the purpose of developing some of the land in the St. Clair flats. This stretch of territory on Lake St. Clair is really a Venice of America in a natural sense. The lots all have water frontage and are desirable for purposes of summer residence. They have been sold at a low price.

Capt. Harry Gunderson, of the steamer Henry Steinbrenner, reports that the slight earthquake at Hancock, Mich., recently, threw Lake Superior into great fury for a few moments, suddenly swinging his ship, which was pointing a little south of west, directly north in spite of all the efforts of the wheelsman to control her.

## LONGSHOREMEN'S STRIKE.

The long expected strike of the International Longshoremen's Marine and Transport Workers' Association was declared at midnight Monday, the docks at lower lake ports being tied up thereby to bulk freight traffic. The agreement of the dock managers with the longshoremen's association expired on May 1. Several weeks ago the dock managers held a conference with the representatives of the longshoremen's association to renew the agreement for 1906. There were certain points of difference between the dock managers and the longshoremen, the most notable of which was that the longshoremen desired a ten-hour day as against an eleven-hour day. After the conference had continued for nearly two weeks, President Keefe of the longshoremen's association suddenly declared that an agreement could not be entered into with the dock managers unless the Lake Carriers' Association recognized the mates' union. As the dock managers have nothing whatever to do with the Lake Carriers' Association, the demand was regarded as wholly an unreasonable one to present to the dock managers and the conference was declared off. No conference has since been held between the dock managers and the longshoremen. The attitude of the Lake Carriers' Association towards the mates was well known as the association had declared at its annual meeting in Detroit that no mates belonging to the union should be carried on its vessels and had instructed the masters of the vessels not to employ union mates. Both sides then rested and May 1 came with no further attempt to avert the strike.

The general feeling is that President Keefe's position in this controversy is unwarranted. The recognition of the mates' union, if any union exists, was an entirely extraneous issue to the dock managers and should never have been projected into their deliberations. It is quite clear also, from the drift of things, that Mr. Keefe is not getting the support that he evidently expected. The mates are not leaving the boats. The few that left during the flurry of the first day have since returned to their boats and there is a practically unanimous disposition on the part of the mates to stand by the ship. There is really no mates' union, strictly speaking. The mates that are in actual service are not union men. What the outcome will be when the longshoremen realize that they are being deprived of their earnings to help a union that has no actual existence remains to be seen. Conservative observers of the situation believe that Mr. Keefe will not be able to hold his own men together. With the exception of the firemen, labor aboard ship has signed for the season and there will be no difficulty whatever in filling the firemen's places, provided the strike is prolonged and it becomes absolutely necessary to operate the vessels.

The operating companies are quite prepared to fight to the finish. A more opportune time in their behalf could not be selected. As far as the independent vessel owners are concerned a few weeks' delay at this time is really an advantage to them. While it may have no effect in actually advancing the freight rate on ore, it will give firmness to the market and a better tone to all the subsidiary trades. The vessel owners are not worried in the least. As far as the great steel making interests are concerned, they have enough ore down to last them until next September, and if occasion required, could move ore under present conditions anyway. The Steel Corporation could operate its docks without extraordinary disturbance at any moment as its docks are equipped with perfect and almost automatic machinery and, moreover, its great South Chicago docks are non-union. Ore on Lake Erie docks at present has been practically sold for several months past. There may be a considerable shifting about of this surplus to supply furnaces that are short of ore, but there will be no actual shortage in supply anywhere. Some of the smaller furnaces are already asking for quotations of ore free on board cars at mine and are negotiating with the railways for its transportation south.

Masters of vessels have performed a royal service for their owners and have met any wavering in the line of the mates. In detached instances, where mates have evinced a desire to quit, they have been told flatly by the masters that they could never return and have thereupon decided to stay. The harbors at lower lake ports are presenting a quiet appearance. Nothing is stirring and there is a total absence of the customary smoke. Freighters as they arrive are anchoring outside so as to avoid congestion. Vessels are steadily being unloaded at non-union docks which include the Lackawanna, Pennsylvania and Lehigh at Buffalo, and the three docks at South Chicago. The tug firemen have been ordered out, but as the boats are not making dock the lack of tug service is not felt. The package freight lines, which are merely adjuncts of the railways, are preparing to send forward their freight by rail.

While at present the lake trade is paralyzed over a waterway 1,000 miles long, it has not, and probably will not affect the general prosperity of the country. The longshoremen, who really are the sufferers, are likely to tire of an impossible situation into which they have been plunged by their leader, long before the influence of the strike could be sensibly felt upon the industry of the country.

## ADOPTS THE WATER LIGHT.

The Cleveland & Buffalo Transit Co. has decided to install the water light manufactured by the Marine Torch Co., of Baltimore, Md., on its fleet of steamers. Mr. Carl Virgin, general manager of the Marine Torch Co. who was in the great lakes district recently visiting vessel owners, left a number of torches with Capt. Hugh McAlpine, master of the City of Erie. On Saturday night last, Capt. McAlpine threw them overboard en route between Buffalo and Cleveland and reported that the torches ignited instantly, making a powerful light which was visible for a distance of twelve miles. Mr. T. F. Newman, general manager of the line, immediately ordered his steamers to be equipped with the torch upon the recommendation of Capt. McAlpine.

As explained in last week's issue of the REVIEW, this torch consists of a can about 9 in. high and 3 in. in diameter. Both on the top and bottom of the can is a strip of soldered tin which can be ripped off just as the torch is being thrown overboard. Water entering immediately generates a gas. At the top of the can is a small chamber containing a substance also generating a gas through the action of water and which instantly causes the gas escaping from the lower chamber to ignite. Therefore nothing is needed to produce a flame except water. It does not matter how completely the light is submerged it instantly relights upon coming to the surface. Nor can wind extinguish it for though it blow the flame away is instantly renews itself. As an emergency light nothing can equal this as it derives its power from the elements which are fatal to other lights. It would be useless to dilate upon the advantages of this emergency light to steamers and wrecking outfits. They are too apparent.

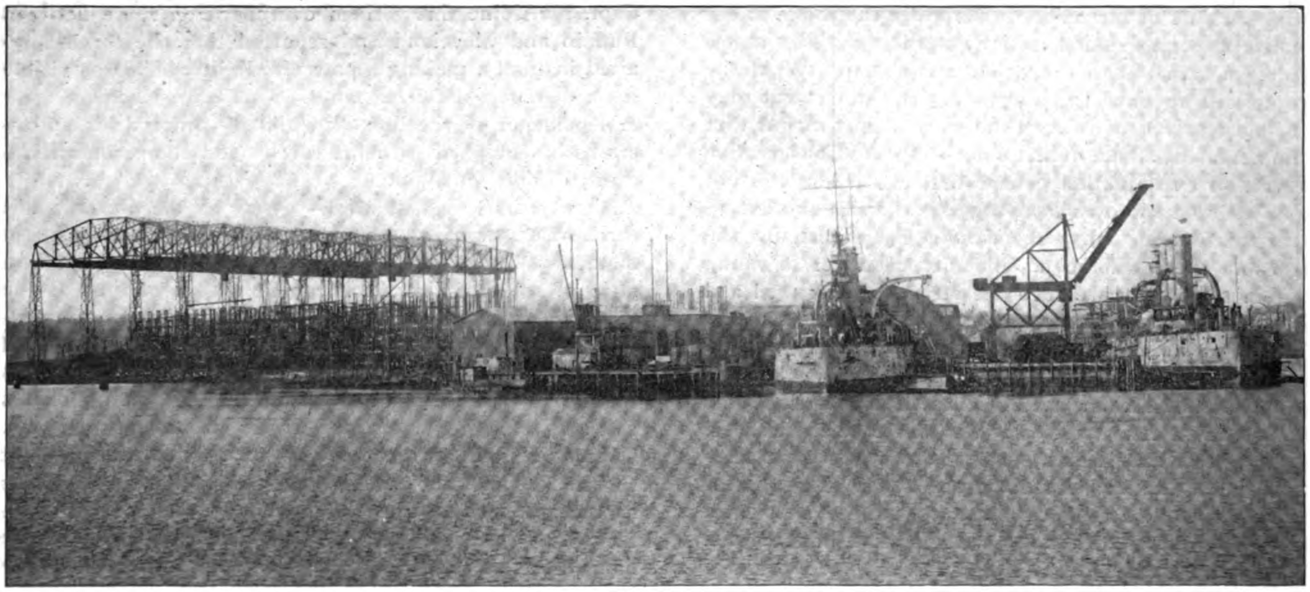
The steamer D. H. Whitney, stranded on Black river shore last week by the parting of her wheel chains.

BATTLESHIP RHODE ISLAND ON BUILDERS' TRIAL, MAKING 19.33 KNOTS.

# FORE RIVER SHIP BUILDING COMPANY'S YARD.

**A Description of a Modern Yard With Special Reference to its Electrical Equipment as Supplied by the Allis-Chalmers Co.—Four Wire Multiple Voltage System.**

The ship yard of the Fore River Ship Building Co., Quincy near Boston, Mass., although opened only a few years ago has already become one of the most important plants on the Atlantic coast for the construction of large ships, and it would be difficult to find one equipped more completely and embodying more of everything that is latest and best in engineering practice. Less than seven years old it has already contributed notable additions to the navy of the United States. The battleship Rhode Island, was turned over to the government on Feb. 12; another 15,000-ton battleship, the New Jersey, is receiving the finishing touches before being placed in commission; and the Vermont is lying along the fitting-out pier receiving its armor and equipment. Two torpedo boat destroyers, the Macdonough and the Lawrence were completed some time ago and two scout ships, the Birmingham, to have



VIEW FROM WATER FRONT SHOWING BATTLESHIPS RHODE ISLAND, VERMONT AND NEW JERSEY.

reciprocating engines and the Salem, which will be driven by turbines, are on the ways. A low, mysterious building near the water front is reported to conceal the beginnings of four submarines. Of merchant ships several have been built and are now building.

Practically every part of a battleship, that most complicated mass of machinery, is constructed within the 78-acre enclosure. The Fore River ship yard is not the result of slow development. It has arisen almost full-fledged without the usual early stages of experiment and trial, the management apparently thinking that whatever can be done elsewhere in a mechanical way can be done as well if not better in New England. Only the steel and the gray iron castings are brought into the yard in a semi-finished state. Even the electric equipment of the warships is now being manufactured upon the ground and the engines, both reciprocating and turbine, are built and finished in the shops.

The plant is situated upon ground lying along the Weymouth Fore river really an arm of Boston harbor and only ten miles from the city. The area has a frontage of one and three-quarter miles. There are fifteen large buildings and a number of smaller ones furnishing a floor area of nearly twelve acres. It would be impossible to compress into a single article descriptions of all the machines and tools employed. Some idea of the magnitude of the works may be gained from the statement that every conceivable labor-saving device is employed and that the number of men at work is something over 4,000. There

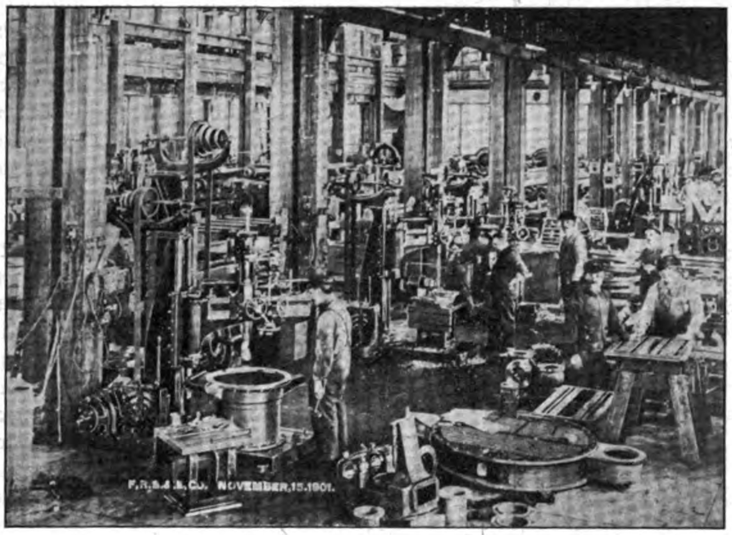


FIG. I.—CORNER IN ONE OF THE SMALLER MACHINE SHOPS.

are about 275 electric motors for driving machine tools, cranes, etc., besides pneumatic ship tools, steam hammers and hydraulic presses.

The most conspicuous structure on the premises is the "ship house" which is merely a huge steel framework for carrying the great cranes commanding every spot of the area enclosed and having a clear lift of about 100 ft., sufficient to carry material to any part of large vessels lying on the stocks within. This skeleton building is 490 ft. long by 325 ft. wide and is divided longitudinally into four bays each equipped with a crane of nearly 80 ft. span. The spreading girders are not intended to support a roof; the form merely exemplies an economical disposition of material for carrying the cranes.

The ship tool shop which adjoins the ship house, is a large building containing practically every known arrangement for shearing, punching and forming plates and shapes into sections of a ship's frame or skin. The tools in this building are admirably arranged for convenience in handling plates of awkward sizes and shapes. The floor surrounding each punch and shear is as free from obstructions as possible, even all motors and wires being kept out of sight, and every large tool being surmounted by a swinging crane so that the men have free access to the work in hand and are free to guide it in any direction.

The main machine shop is remarkable for the number of tools of gigantic proportions which it contains. There are huge lathes for turning the crankshafts of the largest battleships, immense boring mills with revolving platforms flush with the floor, great planers large enough to monopolize the entire floor space of an ordinary custom machine shop, and in the side bays smaller tools of all sizes and for all purposes. In one end of the building the great engines of battleships are set up and fitted, later to be taken down and installed in the hulls of the steamers which they are to drive.

The pattern shop contains a full equipment of the usual wood-working machinery, the upper floor of the building serving as the mold loft where the ships' plates are plotted and outlined. A new blacksmith shop has been added to the plant during the past year. It contains some forty fires and a full equipment of hammers. A portion of the store building is fitted up for the manufacture of electric equipment for the vessels under construction.

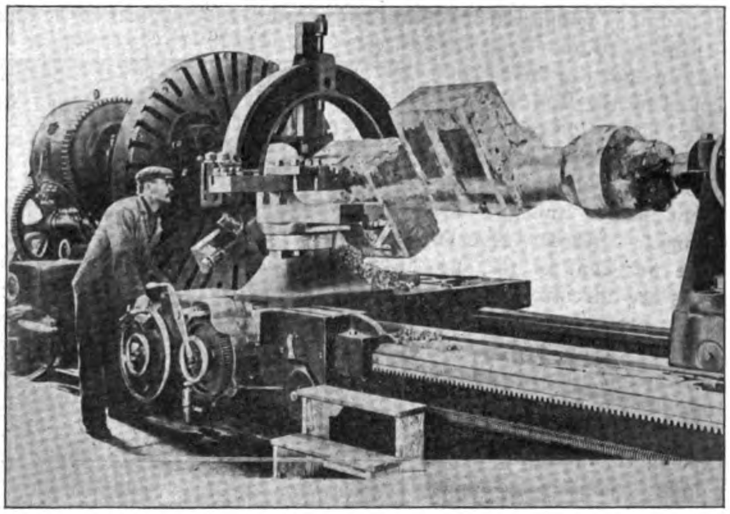


FIG. 3.—MOTOR-DRIVEN LATHE TURNING CRANK SHAFT FORGING.

The forge is the third largest in the United States and the only one in a ship yard capable of turning out the heavy work required in building the largest ships. Propeller shafts and parts of guns are forged under steam hammers. The annealing plant adjoins the forge. It contains oil burning heating furnaces and vertical cylindrical annealing tanks for oil baths. There is a sawmill equipped with a large band saw for cutting the timber used in ships. Also a brass foundry for casting brass valves and bronze and brass parts. No molding machines are used because the work varies constantly, and the metal is melted in crucibles exclusively.

The power house is centrally located and is a building 162 ft. long by 65 ft. wide. There are six 6 by 16 ft. return tubular boilers set in brick and operated at 125 pounds pressure. The boilers are fired by hand, and there are no high chimneys, the Sturtevant system of induced draft being employed. This draft apparatus is with the exception of the main engines and air compressors the only steam driven machinery in the entire yard.

For driving the machinery of the plant there is one 350-kilowatt generator driven by a horizontal

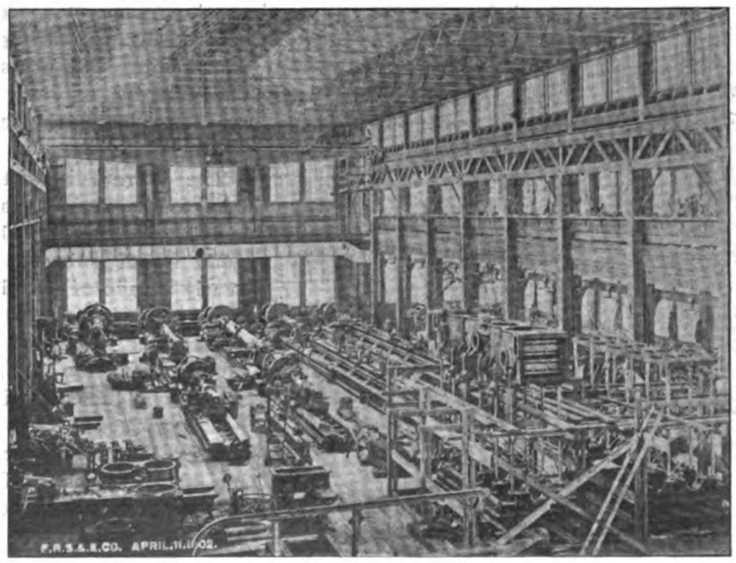


FIG. 2.—ONE END OF MAIN MACHINE SHOP.

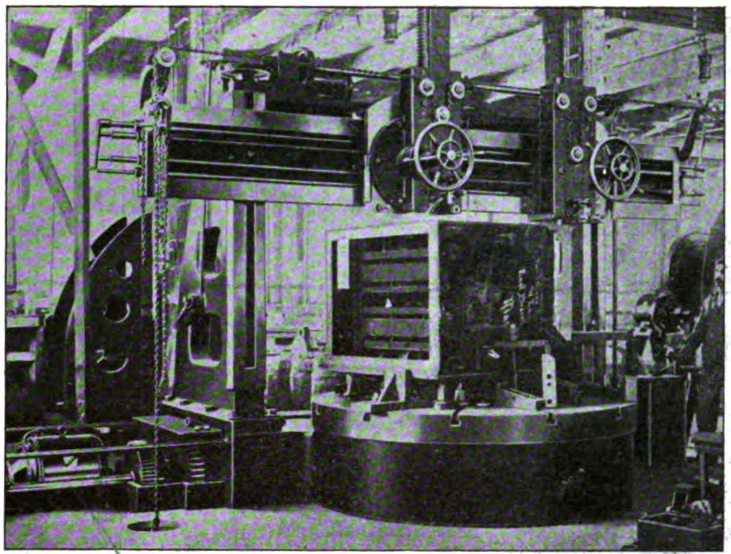


FIG. 4.—MOTOR-DRIVEN BORING MILLS.

Curtis steam turbine; one 300-kilowatt generator direct-connected to a Hamilton-Corliss compound condensing engine; and one 200-kilowatt Bullock generator also driven by a Hamilton-Corliss engine. For operating pneumatic hammers, drills, caulkers, etc., used in ship work there are two compressors, one of the Rand type having a capacity of 5,000 cu. ft. per minute, and another of the Ingersoll-Sargeant type delivering 1,000 cu. ft., both being operated by cross-compound Hamilton-Corliss engines.

The apparatus of the power house is of very simple construction, only one variety of current being generated for all classes of service—direct current at 240 volts. Current is generated for about 275 motors varying in size from ¼ to 100 H. P., the major portion being supplied by the Bullock Electric Mfg. Co. (the Allis-Chalmers Co.), and also for about 4,000 incandescent lamps and 350 arc lamps. About seventy-five per cent of the motors are direct-coupled to the tools which they drive. Some of the remainder are belted and in one or two cases are counter-belted to obtain a high speed, this practice being almost entirely confined to wood-working tools requiring a different method of power application. There are a number of special motor-driven tools designed to facilitate ship building operations. One of these is a counter-sinking machine consisting of a motor geared to a drill stock which holds the tool, the whole being mounted on a hand barrow so that the entire apparatus can be rolled by hand over a plate placed in a horizontal position and the tool brought to its work by merely pressing down in the proper positions.

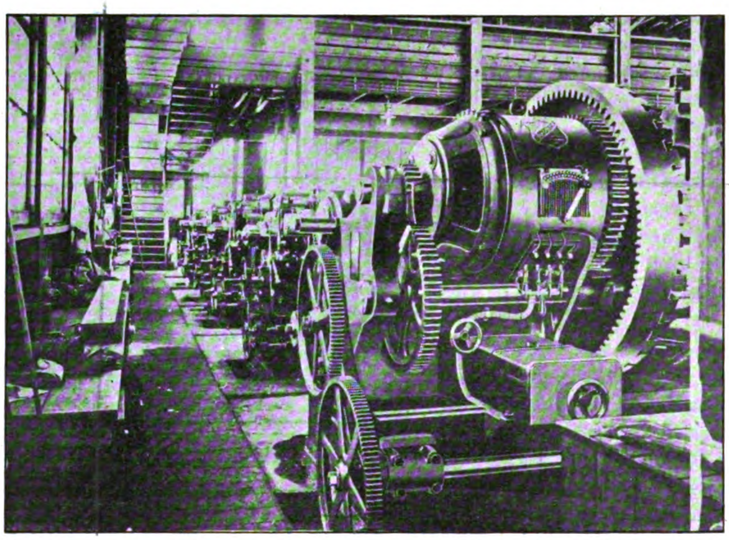


FIG. 5.—HEAD OF STOCKS OF SOME OF THE MOTOR-DRIVEN LATHES.

While the aggregate load of all the motors in the yard is not far from 3,800 H. P. the average load upon the generators is only about 2,400 amperes for both power and lighting, or about 800 H. P. The load varies according to the number of tools actually in operation or in idleness but the figures here given are a fair illustration of the economy of the system of power distribution and subdivision employed in the yard.

FIG. 6.—PORTABLE COUNTER-SINKING MACHINE.

One of the most interesting features of the electric equipment of the Fore River ship yard is the system for speed variations. This is known as the H. Ward Leonard multiple-voltage system. The generator is operated on the two-wire plan supplying the highest voltage, 240 volts, and on this voltage are operated all the constant speed motors, the crane motors and the lighting system of the yard. For variations of speed this voltage is divided into three by means of a balancing transformer located in the engine room and consisting of three similar machines mounted upon a common base. This enables pressures of 60, 80 and 110 volts to be carried between the various pairs of the four wires. By proper combinations a number of pressures may be obtained and with the aid of a small range of shunt field regulation a range of speeds the highest of which is six and one-half times the lowest may be secured. The system is thus one in which the impressed electro-motive force upon the armature of a motor is changed to meet the requirements of speed regulation, or in other words change of speed is secured by increasing or diminishing the pressure and not by varying the resistance as is the usual practice.

The current is distributed to the various buildings by means of about 1,000 ft. of subway and nearly a mile of pole line. The average center of distribution in each building is about 500 ft. from the power house switchboard, and each shop has its own set of mains coming up through the floor to a distributing board and the feeders are led in various directions to the individual tools. The

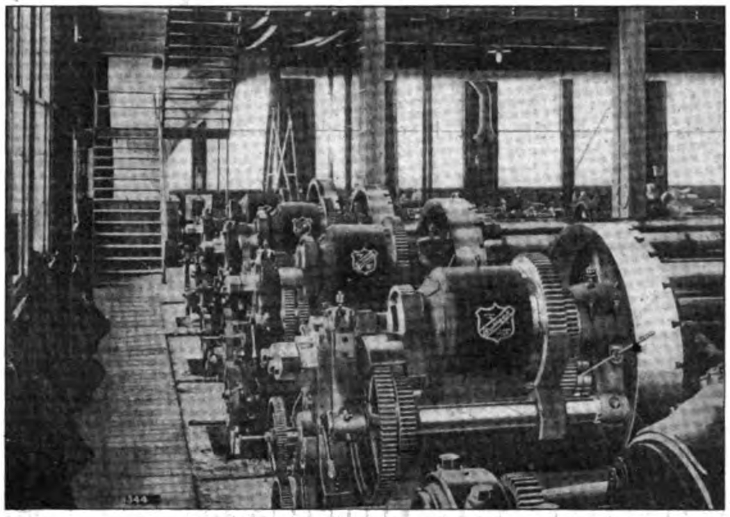


FIG. 7.—FITCHBURG LATHES DRIVEN BY TYPE N ALLIS-CHALMERS MOTORS.

distributing center of the ship tool shop is placed in a gallery above the main floor where the control apparatus of the various heavy tools is also located. One attendant standing in a position whence he can see the operations going on in any part of the shop works all the machines. This removes all the delicate parts such as controllers and regulators from the machines, where in this particular shop they would be especially liable to injury, to a place of safety. In this shop all circuits are run under the floor and brought to the machines through steel circuits, and there are no exposed wires anywhere in the neighborhood of the machines. In the subway the circuits are run upon rubber-covered cables, manufactured by the Standard Underground Cable Co. These are simply nailed to wooden strips, which give sufficient insulation with the low voltage used and the dry atmosphere of the subway. At the center of distribution in the buildings the line is brought up in enameled "electroduct" tubing, and there the main fuses and switches of the machines are placed.

To the casual visitor in the Fore River ship yard no one feature is more interesting than the great variety and number of electric traveling cranes used to facilitate the handling of material. The great crane which reaches every portion of the plate yard adjoining the steel tool shop is the largest of its kind in the world. It has a span of 175 ft. and travels over 1,000 ft. of track. The long driving axle is operated by a motor placed in the center of the span and the lift has a capacity of about five tons. For placing equipment in ships already afloat there are six large cantilever cranes and one big folding jib Gantry crane which travels the entire length of the 1,000-ft. fitting-out pier. This structure which is conspicuous in all views of the yard has no less than seven Bullock electric motors. There are three hoist motors; one 25-ton, another of 50 tons and one for the 10-ton falls at the end of the boom. The remaining motors are employed one for crane travel, two for trolley travel and one for hoisting the boom.

In the large machine shop there is a great crane of about 80-ft. span and 400-ft. travel, and in the ship house four having a runway the entire length of the structure are capable of lifting a 5-ton weight 100 ft. vertically and depositing it at any point within the four sections. In the forge and the annealing plants cranes handle the immense ingots, crank-shafts and gun parts with ease. Every shop has some form of overhead lifting apparatus wherever there is an opportunity to save time and muscular energy. In fact the yard is the best possible field for the student interested in the evolution of the workingman from a mere source of energy to the active intelligence which directs and controls the energy developed by machines. It is difficult to find in the entire plant an example of "labor" in the old sense of the word, the mere play of human muscles.

BULLOCK VARIABLE SPEED MOTORS.

All the large machine tools in which a variation of speed would be desirable are operated by Bullock motors on the four wire multiple-voltage system. In the main machine shop there is one of 30 H. P. mounted upon a 120-in. Niles-Bement-Pond lathe of 108-in. swing; one of 12½ H. P. upon a 72-in. lathe of the same make; Four of 18 H. P. operating 60-in. Fitchburg lathes; Two of 24 H. P. driving 48-in. Fitchburg roughing lathes; and four of 8 H. P. operating one 50-in., two 48-in. and one 36-in. lathe all bearing the Fitchburg name-plate.

In the same shop: one 50-H. P. motor drives a 120-in. Niles-Bement-Pond boring mill; one of 24 H. P. on a 120-in. boring mill of the same make; one of 15 H. P. on a 72-in. Pond boring mill; one of 2 H. P. on a 60-in. Niles boring mill; one of 9 H. P. driving a 50-in. Niles boring mill; and one of 25 H. P. operating a 10-ft. boring mill. There are two of 4 H. P. each on radial drills and two of 45 H. P. on crank turning lathes—an interesting machine in which the great cranks used in large ships are braced against distortion by gravity and by cutting tool travels. A 3-H. P. motor drives a machine for cutting buckets for Curtis turbines, a practice which now has been abandoned. There is an 8-H. P. motor for a multiple spindle drill and another of the same capacity for driving an 18-in. Niles slotter. A second Niles slotter, 25-inch, is driven by an 18-horsepower motor and a similar motor drives a Niles milling machine. A Newton cold saw is driven by an 8-horsepower motor. This shop contains a multitude of other tools and motors. Those here enumerated comprise only those operated on the Bullock four-wire multiple-voltage system.

In the ship tool shop the following machines and motors are operated on the same system, one 24 horsepower driving an angle beveling machine; two of 4 horsepower each on double ended shapers; and one of 1½ horsepower to operate a testing machine for bending and breaking strains. A 100-horsepower Morgan train motor drives a set of bending rolls.

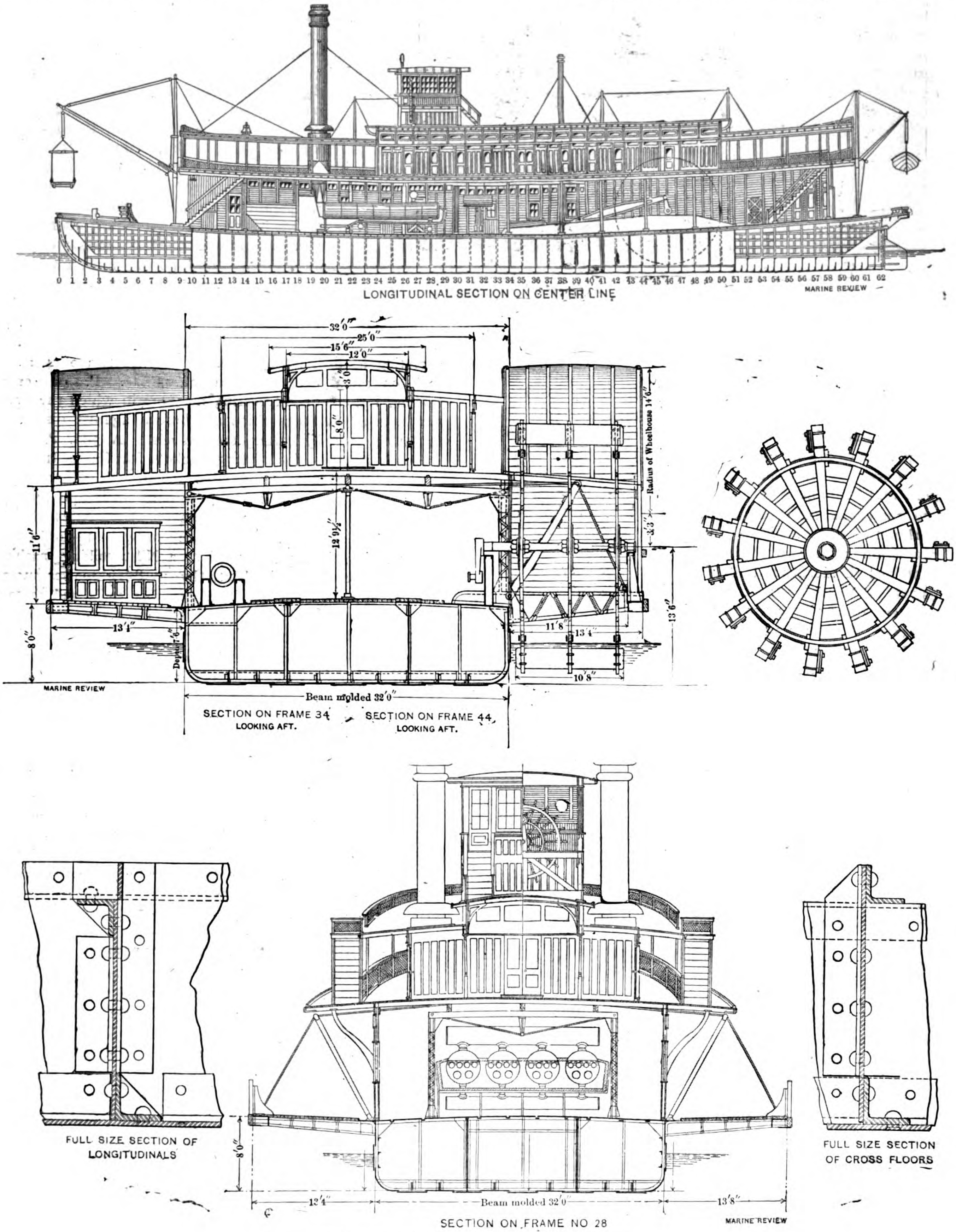
In the store house there is a 4-horsepower motor for operating a Newton cold saw. In the electric machine shop two motors of 4-horsepower drive a 16-inch lathe and an American turret lathe respectively. There is one of 3 horsepower to drive a 30-inch drill press; one of ½ horsepower on another drill press, and a second motor of ½ horsepower for operating a coil winding machine designed on the premises.

## NEW RAILROAD AND STEAMSHIP LINE.

Charter has been granted to the Atlanta, Birmingham & Atlantic Railway Co. for the operation of a steamship line from Brunswick, Ga. to New York. By means of this line Atlanta will have a direct route to New York when the Atlanta, Birmingham & Atlantic is complete. The new venture, the Brunswick Steamship Co. is to construct and operate vessels of all sorts. Following are the officers: President, H. M. Atkinson; vice president, T. S. Arkwright; general manager, C. L. Dimond; secretary and treasurer, R. E. Cullanine. Mr. Atkinson states that while a freight line is to be organized first it is the purpose of the company to establish a passenger service later. He thinks the steamship line will be in operation in about a year and a half.

## HARBOR BOAT FOR ST. LOUIS.

The Springfield Boiler & Mfg. Co., Springfield, Ill., is building a new harbor boat for the city of St. Louis, from designs prepared under the direction of Mr. Joseph P. Whyte, harbor and wharf commissioner of that city. This boat is designed to meet a special use, that of keeping the paved wharf free of river deposits, removing wrecks and for fire purposes. The river deposit is removed by washing, as all levees are paved with granite blocks. For this purpose the boat is equipped with three pumps, using 3-in.



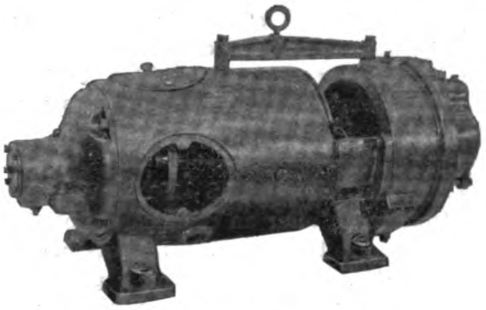

PLANS OF THE HARBOR BOAT FOR ST. LOUIS.

hose. Five streams can be used at one time with a pumping capacity of about 6,000 gallons per minute.

The vessel is 186 ft. long between perpendiculars, 32-ft. beam molded, 59 ft. 4 in. over guards, and 7-ft. 6-in. depth at side moldings. The hull is framed on a combination of the longitudinal and transverse systems. The transverse beams, or frames rather, are placed uniformly 3 ft. centers. The longitudinal system of framing is used between frames No. 10 and No. 51 upon the flat bottom and the transverse system forward and aft of these points and upon the sides of the boat. There are four transverse bulkheads placed upon frames 10, 20, 30, 41 and 51 respectively, each extended from the side of the boat and built of 3-16-in. plate. These work intercostal to the longitudinal bulkheads with the exception of the one on frame No. 10, and on frame No. 51, which are continuous across the boat. The engines of the harbor boat, Mark Twain, will be installed in this boat, but the Springfield Boiler & Mfg. Co. will supply four boilers of the ordinary Mississippi river type, set in one battery. Each boiler will be 44-in. diameter and 26 ft. long, and will have four flues 7-in. and two flues 12-in. diameter.

## STEAM TURBINE MARINE LIGHTING SETS.

The development of the steam turbine for boat propulsion has aroused much interest in this type of engine as a prime mover, but it has also been found well adapted as an auxiliary for lighting and electric power work on shipboard. Curtis steam turbines are being used for this service, taking the



CURTIS STEAM TURBINE.

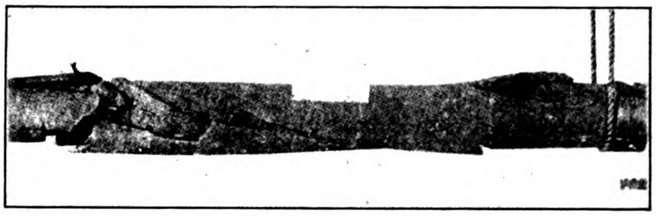
place of marine engine sets. Compactness and smooth running are perhaps the most important attributes of marine machinery, and both these qualities are inherent in the steam turbine generator set. The machine here illustrated consists essentially of a properly governed Curtis steam turbine of the horizontal type direct-connected to a direct-current generator. The turbine casing is bolted directly to projections on the field frame casting of the generator making the whole as compact and simple in construction as possible. This combination possesses all the advantages of rotary over reciprocating motion. An even steady torque is always acting on the shaft and there is no jar or vibration.

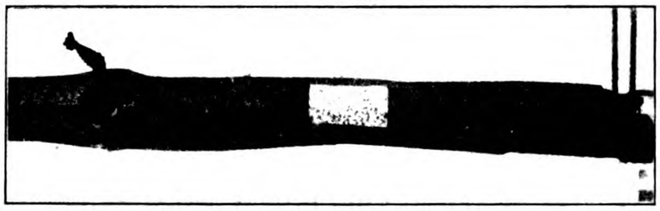
In turbines of 15, 20 and 25 kilowatts capacity, there are but three bearing surfaces, two main bearings and the link between the governor and valve. The main bearings are self-oiling and the governor link requires but one minute's attention once a day. On the other hand, in the reciprocating engine there are a great number of bearing surfaces and moving parts, including cross-head, wrist-pin, crank, eccentric, rocker-arm, etc., in addition to the main bearings. Moreover, an engine cylinder requires internal lubrication and oil getting into the feedwater, causes trouble in the boilers and heaters. The turbine set, on the other hand, needs no internal lubrication, and the constant feed of cylinder oil with its consequent expense, is eliminated. The exhaust steam may be turned into the boilers or heating system with perfect safety. As to steam consumption, it is not possible to make an accurate comparison between small turbines and reciprocating engines as the latter vary greatly; but in this direction the turbine compares favorably with the small marine type of engine.

To sum up, the steam turbine marine generating set combines all the advantages of rotary over reciprocating motion and has been successfully adopted for lighting on ship board. Among the small sets used for this purpose are two 25-kilowatt machines on the recently launched Hendrick Hudson of the Hudson River Day Line boats. This is the largest and finest passenger ship ever built for inland waters, and is equipped with the best and most approved machinery. Two of the Erie ferry boats in New York are also lighted by Curtis steam turbines of this type, and several coast vessels now building in the Fore River and in the Cramp ship building yards are to be furnished with the same compact type of marine lighting sets.

## FRACTURED PROPELLER SHAFT.

James Macdonald, Hong Kong, China, sent to the *Marine Engineer,* London, the following interesting account and illustration of a fractured propeller shaft:





FRACTURED PROPELLER SHAFT OF A STEAM LAUNCH.

"I forward two photos of the fractured part of propeller shaft, belonging to a steam launch, which I noticed in a small launch-building and engineering establishment in this colony. As the fracture was somewhat unique, I got possession of the shaft, and have forwarded it to the Institute of Marine Engineers, London. By way of explanation, I may state that the shaft was of the ordinary type—3½ in. diameter—with two brass liners cast on. The left-hand side of photo represents the forward end of shaft, and the right-hand side, just where the rope is, by which it was slung when photographed, the forward end of the after-liner.

"This shaft belonged to a Chinese launch owned in Canton, and was said to be made in that city from a bar 1 in. larger in diameter than the finished product, although from the appearance of fracture, it would seem as if an outer sleeve (about ½ in. thick) had been filled with a heterogeneous mass of small iron bars, etc., and then, by some means, welded or fused into an apparently solid shaft. The small tuft showing on top left-hand side was a piece of jute, firmly adhering between the apparent sleeve and body of the shaft, while the white mottled part in center is a piece of paper (which had got rusted on), describing shaft while on view in our local Institution of Engineers and Ship Builders, and has nothing to do with the fracture."

The schooner W. O. Goodman, for many years in the Chicago lumber trade, was bought by Mrs. Eliza G. Johnson, of Boston, and will be taken to the Atlantic to engage in the coastwise trade.

## AROUND THE GREAT LAKES

The Donnelly Wrecking Co., of Kingston, has the contract to raise the steamer Zimmerman sunk in St. Mary's river.

The steamer Saxona, which was in collision with the Zimmerman in St. Mary's river, is undergoing repairs at Buffalo.

The name of the steamer Arabia, recently purchased by the Merchants Line, of Montreal, has been changed to Bickerdike.

A revised chart in colors of Lake Superior has been issued by the U. S. Lake Survey and is for sale by the MARINE REVIEW.

The steamer Simon J. Murphy, which struck in St. Mary's river, is in dry dock at Lorain. She had seven plates damaged.

The steamer Hutchinson, which was ashore in St. Mary's river, has several damaged plates forward of the collision bulkhead.

The steamer H. B. Hawgood went aground on Black river, Middleground, Port Huron, last week. She was subsequently released.

It is reported from Toronto, that the Dominion government is considering the construction of an additional ship canal at Sault Ste. Marie.

The Canadian steamer Iroquois, which blockaded navigation in St. Mary's river for the better part of a day, has been taken to Collingwood for repairs.

The steamer Robert Wallace, stranded in making the harbor at Kingston last week, was released after 150 tons of her cargo of grain had been lightered.

Mr. E. E. Upham, a pioneer resident of Duluth, died last week after a continued illness. He was connected with the dredging industry at the head of the lakes.

The MARINE REVIEW regrets to announce the death of Wm. Wharry, wheelsman on the steamer Kensington. He died of typhoid fever in the hospital at Port Huron.

A delegation from Buffalo representing marine interests, visited Washington last week to urge an appropriation for Dunkirk harbor to admit draught vessels in time of storms.

The steamer William Chisholm was disabled by the breaking of a cylinder head while passing through Lake St. Clair, last week. She was towed to the shear dock of the Detroit Ship Building Co., for repairs.

The steamer Starrucca, of the Union Steamboat Line, bound from Chicago to Buffalo with a cargo of general merchandise stranded on South Point last week. A large hole was stove in the bow of the steamer.

Judge Wantry, of the United States Court of Muskegon, has held that the claim of Capt. W. H. Evans for $350, due him as wages on the steamer Chas. H. Hackley, does not take precedence of the mortgage.

The steamer W. D. Rees, owned by the Wilson Transit Co., stranded on Poe's Reef, at the Lake Huron entrance of the straits of Mackinac last week. The wrecking tug Favorite was sent to her relief.

The 569-footer Harry Coulby, left the Wyandotte yards of the American Ship Building Co. on her maiden trip last week. Her cabin accommodations are made extra fine and she is one of the best appointed freighters on the lakes.

The Chattanooga, in tow of the Pioneer, grounded on the east bank at the Lime Kilns, last week. Tugs pulled all day long on the Chattanooga without moving her, and the lighter Newman was then sent for to lighter her cargo.

While the new Gilchrist steamer, John Sherwin, was leaving Bay City on her maiden trip last week, she collided with the Michigan Central railroad bridge, sustaining four broken plates. She went back to the ship yards for repairs.

The steamer Siemens, of the Pittsburg Steamship Co.'s fleet, which was damaged last fall in trying to release the Corey from Gull island reef, Lake Superior, has been taken to the floating dry dock of the Great Lakes Engineering Works, Ecorse, for repairs.

The owners of the steamer C. F. Bielman, have been assessed $42,064 by the Canadian courts as a result of collision in St. Clair river last May which resulted in the loss of the sand sucker Burroughs, owned by C. W. Caldwell, of Windsor. The costs of the suits and 5 per cent interest on award are also charged against the defendants.

The steel steamer Viking, of the Gilchrist fleet, stranded on 19-ft. shoal between the rock and Poverty island this week. The shoal has been developed by the construction of the new Hanna coal dock on the Superior front channel, Duluth-Superior harbor. The shoal is 600 ft. long and extends 250 ft. out from the dock, having 16 ft. of low water. Vessels drawing 17 ft. cannot safely do business at this dock at present.

Some of the vessels that brought down the first cargo of ore this season had been holding it all winter. In trying to unload it, it was found to be so badly frozen that the clamshells could not work in it. The unusual expedient was therefore resulted to of blasting the cargo with dynamite. The process proved so tedious and slow that the boats with frozen ore had to be shifted to make room for others. They were again taken to dock as opportunity offered.

## LAKE SHORE PLANS APPROVED.

The war department, after an examination of the plans of the Lake Shore railway for the improvement of the harbor of Ashtabula, declined to grant a permit for the work. The improvements projected are of the most extensive character and are made necessary by the continued development of lake trade. Mr. Harvey D. Goulder therefore, went to Washington this week and urged the war department to approve the plans after certain modifications had been made. This has now been done and a permit extended to the railway company. The plans, as modified, contemplate leaving a 300-ft. gap between the east arm of the Ashtabula breakwater and the end of the projected new docks. In addition, the railroad company agrees to extend the breakwater if it is found that the docks restrict the basin. Mr. Goulder secured an expression from the river and harbor committee favoring the contemplated improvements and this greatly influenced the war department in granting the necessary permit.

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The Morgan Iron Works, New London, Conn., has been sold to the New London Marine Iron Works Co., a corporation formed to operate it. The officers of the company are: Charles P. Hyde, president and general manager; Morton F. Plant, vice president; P. LeRoy Harwood, treasurer; Charles B. Waller, secretary. The new company takes immediate possession and will put in new ways capable of handling vessels 350 ft. in length. The plant will be enlarged to perform all kinds of repair work on wooden and iron ships, but ship building will not be attempted. Mr. Charles T. Hyde, president of the company, is well known in ship building circles through his long connection with the Bath Iron Works.

## LAUNCHING OF THE HENRY B. SMITH.

The freighter Henry B. Smith, building for W. A. and A. H. Hawgood, was launched from the Lorain yard of the American Ship Building Co. on Wednesday of this week, and was christened by Mrs. H. B. Smith, of Bay City, Mich., wife of the man in whose honor the boat was named. The Smith is in the 10,000-ton class and is 545 ft. over all, 525 ft. keel, 55 ft. beam and 31 ft. deep. She has thirty-two hatches, spaced 12 ft. centers. Her engines are triple expansion with cylinders 23½, 38 and 63-in. diameters by 42-in. stroke, supplied with steam from two Scotch boilers, 14 ft. 6 in. by 11 ft. 6 in., fitted with Ellis & Eaves draft and allowed a pressure of 180 pounds.

Among those present at the launching were Mr. and Mrs. Henry B. Smith, of Bay City, Mrs. Guy H. Moulthrop, of Bay City; Mr. T. J. Lovett, Michael Connelly, J. A. Weisbeck, Miss Wood and Miss Williams of Buffalo; Mr. George Donnenwirth, of Bucyrus, Mr. and Mrs. W. A. Hawgood, Arthur C. Hawgood, Miss Arla Hawgood, Capt. and Mrs. A. H. Hawgood, Miss Aldyth O. Hawgood, Harry B. Hawgood, Mr. Joseph Avery, of Coraopolis, Pa.; Miss Overy, Mrs. Capt. A. B. Keller, Miss Elizabeth Keller, Miss Minnie Jones, Miss Clara Frederick, R. G. Miller, L. J. Cameron, W. E. Ward, Mr. Walters, H. R. Herriman, Robert Logan, R. C. Wetmore, Robert Wallace, Mrs. W. C. Monroe, Miss Dorris Bond, Capt. and Mrs. C. C. Balfour, Thomas Braund, Burton Dake, Harland Newell, Harvey R. Hawgood and Frederick Leckie.

## LUNKENHEIMER BRANCH STORE IN NEW YORK.

The Lunkenheimer Co., of Cincinnati, Ohio, who are the largest manufacturers of high grade engineering specialties in the world, have on May 1, 1906, opened a well equipped branch store, at 66-68 Fulton street, New York city. Previous to the above date, the company maintained a suite of offices in the Havemeyer building, 26 Cortlandt street, through which offices the export trade of the concern was transacted. While the trade in New York city and eastern states were able to a great extent to procure Lunkenheimer engineering appliances from the various supply houses, nevertheless the increased demand for these well known specialties necessitated the opening of a branch from which the supply houses and trade in the New York territory could be instantly accommodated.

It is not necessary that the high standing of the Lunkenheimer company as manufacturers of engineering appliances be called to the attention of users of this class of goods, as their superior products are well known among the trade. The same courteous attention characteristic with the company, will be found to prevail in their new establishment. Being grateful for the patronage of the eastern trade, it is their endeavor to further accommodate the trade by prompt attention to all orders, to do which they have gone to quite an expense by opening their branch store and supplying same with a large and complete line of their many specialties.

## FORCED DRAFT.

"Forced draft," said Admiral Melville in a recent paper, "dates back to Stevens' Rocket, and its first use for marine purposes was by Mr. Robert L. Stevens on the Hudson river steamers in our own country prior to the civil war. During that war Mr. Isherwood built a number of gunboats which used forced draft, but it had fallen into disuse until about 1882 for naval vessels, when it was introduced into the English navy and still later was applied in the merchant service. In naval machinery forced draft has been of the greatest possible importance, because it has reduced boiler weights probably almost one-half. In the navy the natural limitations as to space and weight prevent the use of forced draft with very much economy of fuel. It is obvious that if the rate of combustion is increased from 15 pounds of coal per square foot of grate to 40 pounds, there ought to be an attendant increase of heating surface. In the merchant service, or at least in certain classes of vessels in that service, it is possible to do this, and in one of my annual reports I made a comparison between the boilers of a merchant vessel called the Iona and those of the Baltimore. In the Iona there were 75 feet of heating surface for 1 grate, while in the Baltimore the ratio was about 30 to 1; but had the Baltimore's boilers been designed with any such ratio, their weight would have been almost double the weight of all the machinery of that vessel as actually built."

## GAS ENGINE FOR MARINE PROPULSION.

At the ship building yard of Messrs. Beardmore, the development of the gas engine for marine propulsion is being actively pursued, and one of the problems it is sought to solve is that of stage compression, so that the sudden stress of explosion, which may be 600 pounds, might be reduced, as it naturally causes injury to the parts affected. In the reciprocating engine the pressures in the cylinder are, of course, considerably lower than this, and the wear and tear is therefore less, and the risk of fracture correspondingly so. Submarines are being fitted with gas engines, and though no large vessels have so far been fitted, the prospect of the near future is bright, as many experts are working hard to remove objectionable features.

## APPOINTMENTS OF MASTERS AND ENGINEERS.

L. P. & J. A. SMITH CO., CLEVELAND, O.

| Vessel. | Captain. | Engineer. |
|---|---|---|
| Str. Rhoda Stewart | G. H. Ferguson | |
| Schr. Mikado | ——— | |
| Schr. Potter | Frank Jennings | |
| Schr. Wm. Grandy | David J Gleason | |
| Schr. Racine | Alex. Blakelee | |
| H. P. Baldwin | ——— | |
| Schr. Constitution | ——— | |

## PERSONAL.

Mr. T. R. McCarthy, steamship and freight broker, 404 Board of Trade building, Montreal, has just been appointed agent at Montreal to the Nordisk Skibsrederforfning (Northern Ship Owners' Association) of Christiania, Norway. This association was established in 1889 by the owners of steam and sailing vessels in Norway, Sweden and Denmark for the protection of their interests, both at home and abroad.

M. C. Furstenau, consulting marine engineer and naval architect, announces that he has severed his connection with the firm of Melville & Macalpine, and has opened an office on his own account at No. 308 Walnut street, Philadelphia, Pa.

Wm. H. Taft, secretary of war, has accepted the position of associate justice of the United States supreme court, succeeding Justice Brown, resigned. This appointment removes a very interesting figure from politics.

The steamer Wm. G. Mather, of the Cleveland Cliffs Iron Co.'s fleet, was damaged in collision with the steamer Midland Queen at Amherstburg this week. Two holes were stove in the port side at the water line, and the steamer was taken to the Ecorse yard of the Great Lakes Engineering Works for repairs.

Thomas R. Harvey, the proprietor of Harvey's Marine Bureau at Sault Ste. Marie, accidentally fell overboard the steamer Goodyear near Thunder Bay lighthouse and was drowned. Mr. Harvey was the local manager of the Postal Telegraph Co. and city agent for the Canadian Pacific Railway Co.

# SCIENTIFIC LAKE NAVIGATION.

By Clarence E. Long.

## PROPER, OR COMMON FRACTIONS.

PART IV.

FACTORS AND MULTIPLES.

*The factors of a number are the integers (whole numbers) whose product makes the number.* Note.—An integer is any whole number.

2 and 3 are factors of 6, because 6 is divided exactly by 2 and by 3.

2, 3 and 5 are the factors of 30, because 30 is divided exactly by 2, by 3 and by 5.

*A number that contains another number an exact number of times is a multiple of that number.*

24 is the multiple of 12; 36, 48, etc., are also multiples of 12.

30 is a multiple of 2, 3, 5, 6, 10, 15.

95 is the multiple of what two numbers? Ans. 5 and 19, because 95 contains both 5 and 19 an equal number of times.

Give the two factors of 51. Ans. 3 and 17, because they are the whole numbers, which, multiplied together, produce it; 51 is the multiple of 3 and 17 because it is exactly divisible by 3 and by 17.

PRIME NUMBERS.

*A number that has no factors, except 1 and itself, is a prime number.*

Note.--1 is not considered a factor.

1, 2, 3, 5, 7, etc., are prime numbers.

Name the prime numbers between 10 and 20. Ans. 11, 13, 17 and 19.

An integer that will divide a number without having a remainder is called an *exact divisor* of the number.

Thus, 2, 3, 4 and 6 are exact divisors of 12.

The factors of a number are *exact divisors* of it.

A number that has exact divisors besides itself and 1 is called a *composite number.* Hence, a composite number is always the product of two or more factors.

Thus, 12, 18, 21, 40, etc., are composite numbers.

A number that is exactly divisible by 2 is called an *even number.*

Thus, 10, 12, 16, 18, etc., are even numbers.

A number that is not exactly divisible by 2 is called an *odd number.*

Thus, 3, 5, 9, 11, 13, etc., are odd numbers.

Although *proper,* or *common fractions* are not used as much as *decimal fractions* in navigation, the student should acquaint himself with them as they will help him to learn decimals. There are many cases in which they are used to advantage, as will be presently seen.

When anything is divided into *two* equal parts what is each part called? Ans. ½. Into *three* equal parts? Ans. 1-3. Into *eight* equal parts? Ans. ⅛. Into *nine* equal parts? Ans. 1-9. Into *fifteen* equal parts? Ans. 1-15.

How many *halves* are there in anything? How many *thirds?* How many *fifths?* How many *tenths?* How many *fifteenths?* How many *twentieths?*

There are always two halves in anything; 3 thirds; 5 fifths; 10 tenths; 15 fifteenths; 20 twentieths.

What part of a vessel will each man own when it is divided equally among 8 men? Ans. ⅛. 8 shows that the ownership of the vessel is divided among 8 people, hence, 1 man's share is equal to 1 part of the whole of 8, or ⅛.

A *fraction* is one or more of the equal parts of a unit. Thus, 1 *half* and 2 *thirds* are fractions.

Two numbers, written one above the other with a line between them, are used to express a fraction.

A *fractional unit* is one of the equal parts into which any unit is divided; thus, 1 *fourth* and 1 *fifth* are fractional units of fourths and fifths. Fractional units take their name and their value from the number of parts into which the whole number is divided.

The *terms* of a fraction are its *numerator* and *denominator;* thus, 6 and 7 are the terms of the fraction 6-7; or, the numerator and denominator together are called the *terms of the fraction.*

In fractions the numbers above the line are called *numerators;* the numbers below the line are called *denominators.*

The *denominator* is written below the line. Thus, in the fraction ¾, 4 is the denominator. It shows that something has been divided into 4 equal parts.

The *numerator* is written above the line and shows how many parts form the fraction. Thus, in the fraction ⅞, 7 is the numerator. It shows that the fraction contains 7 of the 8 equal parts.

*Fractions are proper or improper.*

A *proper fraction* is one whose numerator is less than its denominator. Its value is less than a unit. Thus, ½, 1-3, ⅜, ¾ and 2-3 are proper fractions. These are also called common fractions. The value of a proper fraction is, therefore, less than one.

An *improper fraction* is a fraction whose numerator equals or exceeds its denominator. Its value is equal to or is greater than a unit. Thus, 6-6, 10-4, 21-9 are improper fractions. 6-6 equals one whole one; 10-4 equals 2¼; and 21-9 equals 2 1-3. The value of an improper fraction is, therefore, 1 or more than 1.

A *mixed number* is a whole number and a fraction written together. Thus 12 5-9 is equivalent to 12 + 5-9.

The unit which is divided into equal parts is called the *unit of the fraction.*

A fraction whose unit has been divided into *any number* of equal parts is called a *common fraction.*

A fraction whose unit has been divided into tenths, hundredths, thousandths, etc., is called a *decimal fraction.*

To analyze the fraction ⅞: 8 is the denominator and shows that the unit is divided into 8 equal parts; ⅛ is the fractional unit since it is one of the eight equal parts into which the unit is divided; 7 is the numerator and shows that seven of these equal parts are taken; 7 and 8 are the terms of the fraction. It is a proper fraction, since the numerator is less than the denominator.

Five-ninths expressed by figures is 5-9.

Seven-twenty-fifths, 7-25. Nine-eighteenths, 9-18. Twelve-twentieths, 12-20. Twenty-six forty-eighths, 26-48.

*To reduce fractions to higher or lower terms.* Example, ½ is equal to how many fourths? Since 1 is equal to 4 fourths, ½ is equal to one-half of 4 fourths, or 2 fourths, 2-4.

One-third of a mile is how many sixths of a mile? Answer 2-6 of a mile.

One-half of a dollar is how many fourths of a dollar? Answer 2-4 of a dollar.

Name some equivalent fractions for *halves.* Answer 2-4, 3-6, 4-8, and 5-10.

Name some equivalent fractions for *thirds.* Answer 2-6, 3-9, 5-15, 8-24.

Express 2-3 in terms 3 times as great; 4 times as great. Answer 6-9; 8-12.

Multiply both terms of ¾ by 3, and show that the value of the fraction is not changed. Answer 9-12.

Name the equivalent for 4-5; for ⅛; for ⅜: Answer 8-10; 2-16; 6-16.

Change 5-6 to *twelfths.* Answer 10-12. To eighteenths. Answer 15-18.

8-12 are how many *thirds?* Answer 2-3.

Divide both terms of 15-20 by 5 and show that the value of the fraction is not changed. The answer is ¾, which is equivalent to 15-20, since the fractional unit is 5 times as great.

Change 18-36 to an equivalent fraction having a denominator 1 *half* as great; 1 *third* as great. Answer 9-18; 6-12.

Change 9-27 to a fraction having lower terms; 14-21; 25-30. Answer 1-3; 2-3; 5-6.

What is the lowest terms in which 12-24 can be expressed? Answer ½.

Change 9-36 to its lowest terms; 16-20; 32-40; 14-35; 20-25. Answer ¼; 4-5; 4-5; 2-5; 4-5.

Name two common divisors of 18-36; 24-56. Answer 9 and 6; 8 and 4.

*Reduction of fractions* is the process of changing their form without altering their value.

A common factor of two or more numbers is a number that will divide each of them without remainder. The largest number that is a factor of two or more numbers is called the *greatest common divisor.*

A fraction is reduced to *higher terms* when the numerator and denominator are expressed in larger numbers; thus, ¾ = 6-8, or 9-12.

A fraction is reduced to *lower terms* when the numerator and denominator are expressed in smaller numbers; or, a fraction is reduced to its lowest terms by dividing the numerator and denominator by their greatest common divisor. Thus, 8-12 = 4-6, or 2-3.

A fraction is reduced to its *lowest terms* when its numerator and denominator are prime to each other; thus, 4-10 = 2-5; 12-16 = ¾.

Fractions are changed to higher terms by multiplication, and to lower terms by division.

Multiplying or dividing both terms of a fraction by the same number does not change the value of the fraction.

Rule.—To reduce a fraction to higher terms of a given denomination, divide the required denominator by the denominator of the given fraction, and multiply the terms of the given fraction by the quotient.

Change 5-6 to a fraction whose denominator is 30. First divide 30, the required denominator, by 6, the denominator of the given fraction. The quotient 5 is the factor employed to produce the required denominator. Hence, multiply both terms of 5-6 by 5 and 25-30 is the required fraction.

*To reduce a fraction to its lowest terms.*

Divide the terms of the given fraction by their greatest common divisor.

Reduce 12-16 to its lowest terms. The greatest common divisor of 12 and 16 is 4, which is contained in 12, 3 times and into 16, 4 times, or ¾, their being no difference whatever in 12-16 and ¾. Bear this in mind.

Reduce to their lowest terms.

288-360, 258-282, 288-504. The answer to the first is 4-5; the second is 43-47, and the third 4-7.

*To reduce a whole number to an improper fraction.*

Rule.—Multiply the whole number by the required denominator and under the result write the required denominator.

In 3 miles how many fourths of a mile? Since in 1 mile there are 4 fourths, in 3 miles there are 3 times 4 fourths; Hence 3 = 12-4.

Don't forget that 3 whole ones and 12-4 are the same.

In 4 bushels how many eighths of a bushel? Answer 32-8. There is no difference between either of these.

How many 9ths in 5? Answer 45-9.

How many tenths of a dollar in $7. Answer 70-10. 70-10 are the same as 7 whole ones.

How many half dollars will pay for a ton of coal that cost $7? Answer $\frac{14}{2}$. Bear in mind that $\frac{14}{2}$ are the same as 7 whole ones.

In the above cases we have no numerators to add, the whole numbers being multiplied by the required denominators.

*To reduce a mixed number to an improper fraction.*

Rule.—Multiply the whole numbers by the denominator and add in the numerator of the fraction, and under the result write the denominator.

In 5⅜ how many eighths? Since 1 is equal to 8 eighths, 5 equals 5 times 8 eighths, or 40 eighths, and ⅜ added make 43-8. Hence, 5⅜ = 43-8.

In 6¾ cords of wood, how many fourths of a cord? Answer 27-4.

How many sixths in 8 5-6? Answer 53-6.

Among how many boys can you distribute 5¾ quarts of chestnuts, if you give ¼ of a quart to each? Answer 23 boys.

Among how many poor sailors can 4 5-6 tons of coal be distributed, if each sailor receives 1-6 of a ton? Answer 29. Remember that there is no difference whatever between 4 5-6 and 29-6.

Examples for practice. Change 75 to the form of a fraction having 27 for its denominator. Answer 2025-27.

Change 81 to a fraction having 24 for its denominator. Answer 1944-24.

In 78 pounds how many sixteenths of a pound? Answer 1248-16.

In 42 6-7 weeks, how many sevenths of a week? Answer 300-7.

How many twentieths of a ton in 16 17-20 tons? Answer 337-20.

Reduce 204 11-24 days to 24ths of a day? Answer 4907-24.

*To reduce an improper fraction to a whole or mixed number.*

Rule.—Divide the numerator by the denominator.

How many units are 18-4? Answer 4 2-4, and 2-4 reduced to its lowest terms is ½, or 4½. Since 4-4 equals 1, 18 fourths equals as many units as 4 fourths are contained in 18 fourths, which is 4 2-4 times.

How many times 1 are 28-7? Answer 4 times.

How many times 1 are 46-8? Answer 5 6-8 times.

How many times 1 are 75-12? Answer 6 3-12.

How many yards are 27-3 yds.? Answer 9 yds.

How many dollars are $36-8? Answer $4 4-8, or $4½.

In 90-12 feet how many feet? Answer 7 6-12, or 7½.

In 108-9 of an acre, how many acres? Answer 12.

In 180-20 of a ton, how many tons? Answer 9.

How many rods in 525-40 of a rod? Answer 13⅛.

*To reduce fractions to equivalent fractions having a given denominator.*

Rule.—Divide the proposed denominator by the denominator of the given fraction, and multiply both terms of the given fraction by the quotient. Thus, reduce 3-7 to fourteenths—

14 ÷ 7 = 2. 3-7 × 2-2 = 6-14 Ans.

How many 4ths in 1? Answer 4 fourths.

How many 4ths in ½? Answer 2 fourths.

How many 9ths in 1? Answer 9-9.

How many 9ths in 1-3? Answer 3-9.

How many 9ths in 2-3? Answer 6-9.

Express 2-3, ½, and ¾, each as twelfths. Answer 2-3 = 8-12; ½ = 6-12, and ¾ = 9-12.

Change ¾ and ⅝ to fractions of the same denominator. Answer 12-16 and 10-16.

Do you thoroughly understand now that it takes two ½ to make a whole one, and 3-3, 4-4, 5-5, 6-6, 7-7, 8-8, 9-9, 10-10, 11-11, and so on, to make a whole one; that ½ of ¼, is ⅛ and ½ of ⅛ is 1-16, ½ of 1-16 is 1-32, etc?

A *multiple* of a number is a number exactly divisible by the given number. A number may have an unlimited num-

ber of multiples. Thus, the multiple of 5 is 5 itself, 10, 15, 20, 25, etc. The multiple of 3 is 3, 6, 9, 12, 15, etc.

A *common multiple* of two or more given numbers is a number exactly divisible by each of them; thus, 10 is a common multiple of 2 and 5, also 20, 30, 40, etc., are common multiples of 2 and 5.

The *least common multiple* of two or more given numbers is the least number exactly divisible by each of them. Two or more numbers can have but one least common multiple. Thus, 20 is the least common multiple of 2, 4 and 5.

What is a multiple of 4, 6, 8? Answer 24, 18 and 32.

What is a common multiple of 3, 4, and 6? Answer 12.

What is the least common multiple of the denominators of ½, ¾, ⅝? Answer 8.

Of 2-3, 2-9 and 5-6? Answer 18.

Reduce 2-3 and 1-9 to 18ths. Answer 2-3 = 12-18 and 1-9 = 2-18.

Name some fractions that can be changed to 16ths. Answer ¼, ⅜ and ½.

Name four fractions that can be changed to 24ths. Answer ½, ⅝, 1-6 and ¾.

A *common denominator* is a denominator common to two or more fractions.

The *least common denominator* of two or more fractions is the least denominator to which they can all be reduced.

Since all higher terms of a fraction are multiples of its corresponding lowest terms, hence the following:

A common denominator of two or more fractions is a common multiple of their denominators.

The least common denominator of two or more fractions is the least common multiple of their denominators. To reduce two or more fractions to equivalent fractions having a common denominator, multiply the terms of each fraction by the denominators of all the other fractions.

Reduce ½, 2-3 and 3-5 to equivalent fractions having a common denominator. Multiply each denominator by the other two, thus, 2 × 3 × 5 = 30, and the product 30, is a common denominator of the three. But since the value of the fraction is not to be changed each numerator must be multiplied by the same number as its denominator. Thus, ½ = 15-30, found thus: We multiply the denominator 2 by the product of the other two denominators (3 × 5 = 15) times the denominator 2 is 30 and multiplying the numerator 1 by the same number, which is 15, so as not to alter the value of our fraction we get 15-30. The next fraction 2-3 is found in the same manner, thus we multiply the denominator 3 by the product of the other two which is 2 × 5 = 10 × 3 = 30; and multiplying the numerator 2 by the same number, which is 10, we get 20-30. 3-5 would be 2 × 3 = 6 × 5, the denominator equals 30 and multiplying the numerator 3 by the same number gives us 18-30.

Reduce to fractions having a common denominator: 3-7 and 5-9. The common denominator of 3-7 and 5-9 is 63, and 3-7 = 27-63; found thus, multiplying the denominator 7 by the other denominator 9 we get 63, and multiplying the numerator 3 by the same number, so as not to change the value of our fraction (3 × 9 = 27) we get 27-63, and multiplying the denominator 9 by the other denominator 7 we get 63 and multiplying the numerator 5 by the same number we get 35-63.

*To reduce fractions to their least common denominator.*

Rule.—Find the least common multiple of the denominators of the given fractions for their least common denominator. Divide this common denominator by the denominator of each of the given fractions, and multiply its numerator by the quotient. The products are the new numerators. Mixed numbers must first be reduced to improper fractions.

Change 2-3, 5-12 and 7-15 to equivalent fractions having the least common denominator.

First find the least common multiple of the given denominators, which is 60; found thus:

| | | | |
|---|---|---|---|
| 3 | 3 | 12 | 15 |
| | × 1 × | 4 × | 5 = 60 |

2-3 = 40-60 | 5-12 = 25-60 | 7-15 = 28-60.

To find the least common denominator of two or more fractions find the least common multiple of their denominators; thus, first write down separately the denominators of each fraction in a line and divide by any prime number that will exactly divide two or more of the given numbers and write the quotients and undivided numbers in a line underneath. In like manner divide the quotients and undivided numbers until they are no longer divisible. The product of the divisors and the final quotients and undivided numbers is the *least common multiple.*

Reduce 2-3, ¾, 7-12, 9-15 to similar fractions having their least common denominator:

| | | | | |
|---|---|---|---|---|
| 3 | 3 | 4 | 12 | 16 |
| 2 | 1 | 4 | 4 | 16 |
| 2 | 1 | 2 | 2 | 8 |
| | 1 | 1 | 1 | 4 |

3 × 2 × 2 × 4 = 48.

Explanation.—The least common denominator cannot always be easily found by inspection. It may be found as above.

Since the least common denominator must be the smallest number that will contain each of the denominators and *no other factors.* The prime factors are found as above. 3 is a prime factor of 3 and 12, and consequently a factor of the least common denominator. Dividing by 3, and writing below the quotients and numbers of which 3 is not a factor, we have, 1, 4, 4, 16. Dividing by 2, and again by 2, the factors of the denominator are found to be the divisors 3, 2, 2, and the factor 4 in the last row. Their product is 48, the least common denominator. The fractions thus become 32-48, 36-48, 28-48, 27-48.

Note.—Fractions should first be reduced to their lowest terms. In finding the factors of the least common denominator a number that is a factor of another number may be disregarded. Thus, since 3 and 4 are factors of 12, they might have been disregarded, and the factors of 12 and 16 only found.

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It is reported in San Francisco that the Oceanic Steamship Co. will be sold to Japan if congress defeats the shipping bill now before it. The statement of Mr. Eugene F. Loud before the committee on merchant marine and fisheries at Washington has been corroborated by Mr. Frederick F. Samuels, manager of the foreign shipping department of the Spreckels line. It is the contention of the company that it is impossible to operate between San Francisco and Australia without government support. Mr. Samuels states that the cost of operation is too high to compete with other lines.

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The Smooth-On Manufacturing Co., Jersey City, N. J., has just issued an illustrated catalog No. 5 concerning Smooth-On iron cements, Smooth-On sheet packing, Smooth-On corrugated steel gaskets, showing when, where and how to use them. The different Smooth-On cements are explained in the catalog and photographs are also submitted showing actual subjects upon which the composition has been used with great success. The catalog, while compact, is very thorough, and should be of great interest to users of machinery.

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George B. Hibbard, a well known marine lawyer, died in Buffalo last week at the age of eighty-two years.

## FROM AFRICA TO LIVERPOOL BY JURY RUDDER.

The story of how the African liner Nigeria (managing owners, Messrs. Elder, Dempster & Co.), was navigated by jury rudder, from the remote shores of West Africa to the Mersey, a distance of about 4,200 nautical miles, will for long years be a cherished narrative as well by seamen as by marine engineers, to five of the latter of whom belongs the glory of having made the accomplishment possible. The Nigeria while on a voyage from Liverpool to Forcados—one of the West African ports—struck the bar at the entrance to the Forcados river and remained fast. Repeated attempts were made to tow the steamer off, but every time the effort was frustrated through the heavy seas running at the time. After about 400 tons of her cargo had been jettisoned, a further attempt to tow the Nigeria off was made on July 2. This time the operation proved successful, but only at the expense of the rudder and rudder-post, which were ruthlessly carried away. Forcados anchorage being about twenty miles distant from the bar, the steamer was partly towed and partly drifted to the mooring ground, where at length she was safely anchored. Conscious that the towage of a vessel of the size and value of the Nigeria from Forcados to Liverpool would be an expensive and—bearing in mind the strong trade winds which would inevitably have to be encountered—a dangerous expedient, it was decided to try and rig up a jury rudder and rudder-post strong enough to take the ship home unassisted under her own steam. The chief engineer of the Nigeria, Mr. Alex. Craigie, was consulted as to the possibility and practicability of such a course of action, and, after due reflection, he volunteered to essay the task involved—a task, be it confessed, of such magnitude and difficulty as might have appalled a less stout-hearted and less skilled engineer. With him in the plucky project Mr. Craigie had the loyal support of his staff—second engineer John Walker Kerr; third engineer T. E. Richardson; fourth engineer, L. D. Risk; and fifth engineer J. V. H. Bowen.

An examination of the damage sustained by the ship was made, when it was found that the rudder had been broken off at the coupling, part of the coupling being also broken; the rudder-post was found to be broken off close up to the arch, and a long boat-hook failed to find any part of the post under water. Besides all this dire and grave injury the rudder-stock was found to be badly bent and twisted, thus adding to the formidable nature of the work to be undertaken. Despite all this, however, Chief Engineer Craigie, after conferring with his assistants, came to the conclusion that the jury rudder could be successfully fitted. Upon this decision a visit was paid to the Niger company's works on the west coast of Africa, with a view to ascertaining what material could be procured with which to carry out the herculean job. Sufficient channel and scrap iron was, luckily, forthcoming, to obviate the necessity of cutting up any part of the ship for material.

As the Nigeria had a full cargo on board—less, of course, the 400 tons previously alluded to as having been jettisoned—it was decided in the first instance to discharge the cargo, then fill the forehold with water to tip the ship, and as there was a rise and fall of the tide of about 4 ft. it was also planned to pull the steamer as far up on the bank of the river as possible. It was expected that the Nigeria would thus be got down to a 9-ft. draught aft. The calculations of the engineers were made accordingly. All this having been successively achieved, a wooden rudder was made, 15 ft. long by 4 ft. 6 in. wide, composed of 4½-in. pitch-pine planks bolted together with 1-in. diameter bolts, and sheathed with ¼-in. plate, the plate being fastened with ½-in. rivets. One of the principal difficulties to be surmounted was the fastening of the jury rudder to the rudder-stock. To accomplish this the broken flange was cut away and the sides leveled off; templates were made, and two cheekplates were formed by riveting two ½-in. steel plates together and bending them to shape, the bend on the port plate being much larger than that on the starboard side, to compensate for the bend in the rudder-stock, and to bring the pintles into line with the center of the ship. Eleven 1⅛-in. bolts were used to fasten the cheekplates to the rudder-stock. The cheekplates came down over the rudder about 3 ft., and the rudder was fastened to them by ten 1-in. bolts and three 1⅛-in. bolts, the 1⅛-in. bolts also going through the top pintle band.

There were four pintles; the top gudgeons of the original post being above the fracture it was utilized, and for the other three the gudgeons and pins from the cargo derricks were used. Three of them were cut off the masts; pieces of hard wood were fitted to the backs of them to level them, and then riveted to stout plates to attach them to the post. The pintle bands were simply bent round to fit the pintles and rudder, and a piece of flat iron was bent and fitted into the band close up to the pin to take up the play of the pin in the band.

The rudder-post was formed of two channel-bars, 9 in. by 4 in., one on either side of the stern frame, and bolted to it by means of ten 1⅛-in. bolts. Two other channel-bars (the Niger company's slipway racks) were fastened to the ship's counter and carried down as far as the bottom gudgeon, being fastened to the post by four 1-in. through bolts, a block of pitch-pine wood being inserted between the bars forming the post. These stays were designed to take up the side strain on the rudder-post. Another stay on either side was fastened immediately above the side-stays and carried as far forward as possible, just clearing the propeller blades. These stays were to take up the after-drag of the rudder and post, and were formed of two 3-in. by 3-in. angle-irons, placed flange to flange and bolted together. Two other stays or struts were attached, one end to the side stays and the other end to the top of the arch. These were meant to stiffen the side stays, and also to assist in taking up any forward strain due to the ship going astern, or a following sea striking the rudder.

Bolts were used in most of the work, as rivets were not available. As the rudder-stock was twisted at least 45 deg. to port, the starboard steering-chain was shortened, and the port chain lengthened to enable the rudder to be put hard over to either side, as the steam-steering gear was to be used all the way to Liverpool. A stout shackle was fastened to the rudder, and preventer ropes were attached to it in case of the rudder fastenings giving way. To assist the cheekplates in the twisting motion a channel-bar was fastened down the front of the rudder-stock by five 1-in. tap-bolts, and carried out to the full width of the rudder. A piece of ⅝-in. plate was fastened to it on either side and to the rudder. Two other channel-bars were fastened above the cheekplates and carried out diagonally to the edge of the rudder.

The completed jury rudder represented a very substantial job, and looked capable of taking the ship anywhere. As subsequent experiences showed, it was well such a splendid strong finish had been put to the work, as the vessel encountered very heavy weather during the homeward passage, a full gale raging for three days off the Portuguese coast. Notwithstanding the stress of weather, however—or, perhaps, rather because of it—the faith of the five engineers in their work was abundantly justified. It might be parenthetically added that when the jury rudder was completed a trial trip was made in the Forcados river. With such admirable proficiency and normal sensitiveness did the jury rudder obey in the course of this preliminary spin, that Lloyds' agents on the coast unhesitatingly gave a certificate testifying

to the fact that the steamer was perfectly sea-worthy, and that the rudder was an efficient piece of steering apparatus. The voyage back to Liverpool was commenced on August 25, and by September 20 the Nigeria was docked in the Mersey.

The arduous nature of the work will be better appreciated and understood when it is stated that it was done in the middle of the rainy season, in a most unhealthy climate, and with few appliances at the engineers' disposal. Fortunately the engineers escaped the attacks of the dreaded malaria. From the time the ship was tipped until she was ready for sea with her jury rudder complete, sixteen days' hard and continuous work was put in. This, of course, is taking no account of a considerable amount of preparatory work, which had to be carried out before the steamer was tipped.

When the Nigeria arrived at Liverpool she was placed in graving dock, where the ingeniously-constructed jury rudder was inspected and greatly admired by a large number of well-known engineers and others. Sir Alfred L. Jones K. C. M. G., principal of the firm of Messrs. Elder, Dempster & Co., was particularly pleased with the achievement.

## MARINE BOILER EXPLOSIONS.

Following are some of the more interesting reports of the British Board of Trade on recent marine boiler explosions:

Report No. 1,535 deals with an explosion from the starboard main boiler of the Duneric, a vessel belonging to Glasgow. She is a vessel engaged in the Mediterranean trade, and is fitted with two single-ended two-furnace boilers, loaded to 165 lbs. At 6 a. m. on November 23 last, the vessel sailed from Newport, Monmouth, with a cargo of coals, and 30 minutes later the starboard boiler furnace crowns collapsed, and steam issued from the furnaces. The fires were drawn, and the vessel brought back to Newport by means of the port boiler. At the time of the explosion there was 150 lbs. pressure on the boilers, and the starboard boiler showed a full glass. The chief engineer blew the glass through twice, and after the second time, the water did not return into the glass. The bottom test cock was then opened, and steam issued. The boiler was pumped out, and an examination made. A line indicating the water level was distinctly marked around the inside of the boiler about eight inches below the furnace crowns, and above this the combustion chamber plates were discolored, and pockets were formed along the top of both furnaces. The water gauge had a quantity of muddy deposit, preventing a clear passage through the various cocks. The cause of the shortness of water was, therefore, plain.

Report 1,537 deals with an explosion on the Bermudian on November 4 last, the vessel being a new one at the time. She was built at Sunderland, and was still in the hands of the builders. Steam had been raised the day previous to adjust the safety valves, and after this, one boiler was kept under steam to supply the auxiliary machinery. The following morning the vessel was lying on the mud with a list to starboard. Steam was afterwards raised on other boilers to try the machinery, and probably during this period water collected at the low portion of the pipes. A certain quantity of water was also run into the double-bottom tanks at the time. One of the tanks had a center-line bulkhead, and in order to bring the vessel upright, the water was pumped out of the starboard side of this tank. The engine stop valves were opened just before noon to turn the engines, and at noon the vessel floated, and immediately took a list to port. This was followed by a rattling noise in the steam pipes, and then by a loud report and a rush of steam, due to the bursting of a stop-valve chest. Evidently when the vessel altered her list, the water in the steam pipes moved, and so the explosion resulted from the waterhammer action.

Report No. 1,543 deals with a steam-pipe explosion on the Yarborough on August 13, last year, when the vessel was about 16 hours out from Port Talbot, on a voyage from that port to Pensacola. It was due to the usual causes, bad weather and light draught, causing the engines to race heavily. The branch pipes next the boiler stop valves of both boilers gave way at the flanges, and the vessel put into Queenstown under reduced steam, where sleeves and new flanges were fitted.

Report No. 1,544 deals with an explosion from the main boiler of the fishing vessel Eagle on January 18 last, when the vessel was about 70 miles off the mouth of the Humber. She left Grimsby on the 12th of that month for the fishing grounds, and continued fishing till the day of the explosion, which was due to one of the bottom stays in the port combustion chamber fracturing, and being blown out by the pressure of the steam. The engine driver was, unfortunately, scalded in drawing the fires. As the engine room staff could not do anything in the way of repair, another steam fishing vessel took the Eagle in tow to Grimsby.

Report No. 1,546 deals with an explosion from the starboard main boiler of the Lady Palmer on December 23 last, when the vessel was on a voyage from Hull to Rio Janeiro. The vessel was 20 days out, in the South Atlantic, at the time of the explosion, which consisted of the blowing out of four studs from a crack in the lower starboard furnace, the boiler being of the single-ended type with four furnaces. The watch had just been changed, and a fireman was in the act of cleaning the fire of the furnace which failed, when the explosion occurred; the fireman and his mate escaped without injury, but another fireman, who had been on the previous watch, returned to the stokehold for his pipe, and must have been overcome by the steam, as he was afterwards found on the stokehold plates, dead. As soon as it was possible the fires were drawn, and the vessel proceeded with the port boiler, whilst repairs were being done, and when these were completed, both boilers were again used at a reduced pressure. It seems that leakage had occurred from the crack, and no doubt this wasted the threads of the studs.

Report No. 1,548 deals with an explosion from the starboard main boiler of the Kairos on November 29 last, when the vessel was 115 miles from Alexandria, on a voyage to Constantinople. The boilers are of the single-ended type with three furnaces each, being made in 1893, when the original compound engines were tripled. The vessel left Blyth on October 25, 1904, and arrived at Alexandria November 15, laying under banked fires till the 29th, when she left for Constantinople at 6:40 a. m. About 13 hours later, when the fire in the starboard furnace of the starboard boiler was being cleaned, water was seen issuing from behind the furnace door plate. The fires were accordingly drawn, and the door plate removed, when the furnace was found to be cracked through the root of the flange at the top for about 19 inches in length. The vessel was accordingly taken back to Alexandria for repairs. Examination there showing that considerable grooving had taken place, resulting in the plate becoming too thin to withstand the working pressure.

Report No. 1,551 deals with an explosion from the steam trawler Captain on March 22 last, when the vessel was about 20 miles east of May Island. The vessel had sailed from Granton on the morning of the explosion for the fishing grounds, which occurred in the afternoon, about 6½ hours later. The bottom of the boiler gave way, and the water rushed into the engine room. The fires were drawn and the safety valves eased, and later the manhole doors were taken off to ascertain the damage, which consisted in the giving way of a small piece of the bottom at the back end, where the plate had thinned for about 16 inches. One man was scalded on the foot, and the vessel was towed back by another trawler.

# WANTED and FOR SALE Department.

## PROPOSALS.

U. S. Engineer Office, Buffalo, N. Y., April 20, 1906.—Sealed proposals in triplicate for construction of stone breakwater at South Harbor Entrance, Buffalo, N. Y., will be received here until 11 A. M. May 21, 1906, and then opened. Information furnished on application. H. M. ADAMS, Col. Engrs.

U. S. Engineer Office, Jones Building, Detroit, Mich., April 14, 1906. Sealed proposals for dredging Round Island Shoals, St. Marys River, Mich., will be received at this office until 2 p. m. May 14, 1906, and then publicly opened. Information furnished on application. CHAS. E. L. B. DAVIS, Col., Engrs.

## WANTED

### Marine Railway

WANTED: A Marine Railway of 1,000 tons capacity. Send particulars to D. G. DOBSON, Box 83, Midland, Ont.

### Wanted.

Lighter to carry 1,000 tons. Two second-hand McMyler hoists with chain sheets
Address LIGHTER,
care Marine Review.

## FOR SALE.

### Coal Buckets.

Twenty-six long 5-ton Coal Buckets in good condition.
M. A. HANNA & CO.,
Ashtabula, O.

## FOR SALE.

### Fishing Tug.

Gasoline fishing tug in A1 order, three years old, 43 ft. long, 9 ft. beam; has an 18 H. P. gasoline engine. The price is right. Address
M. RYAN & CO.,
223 Erie St., Buffalo, N. Y.

### Marine Railway

FOR SALE.—Marine Railway 1,000 tons capacity, Boat Railway, 45 rods land, about 170 feet water front buildings. Two boilers, one is new, machinery and sawmill, etc. ABRAM CHACE, 507 Kempton St,, New Bedford, Mass.

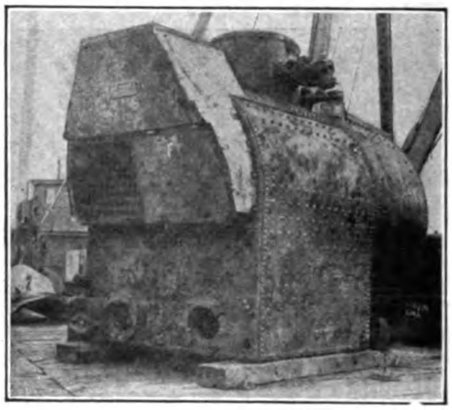
### Lumber Barge.

For sale cheap, Lumber Barge; capacity five hundred and eighty thousand. For full particulars inquire Box 96, MARINE REVIEW, Cleveland, O,

### A Bargain.

Steamer E. F. Gould, length 137 ft., width 28 ft., depth 8 ft. 5 in., tonnage 261 tons. Boiler, engine and hull in good condition. First-class, complete sand pumping outfit now installed on boat, will sell with boat if so desired. Apply
JOHN M. McKERCHEY,
Detroit, Mich.

## FOR SALE.



### FOR SALE.

Boiler about 1 year old, good order, 9 ft. 5 in. face, 13 ft. long, 125 pounds steam.

MERRITT & CHAPMAN
DERRICK & WRECKING CO.,
17 Battery Place, N. Y.

### For Sale.

Five Scotch Boilers, allowed 160 lbs. steam. Good as new. ERIE MACHINERY CO., 729 Garfield Bldg., Cleveland, O.



### Boiler Wanted.

Wanted Marine Boiler, Fire Box or Scotch Boiler of equal capacity, 9' to 9' 6" dia., 14' to 16' long, 100 lbs. steam or more. Give full description when, where and by whom built and steam pressure allowed. Box 83, Cleveland, Ohio.

# Buyers' Directory of the Marine Trade

For a more complete classification than that represented by advertisers in the Marine Review, see the BLUE BOOK OF AMERICAN SHIPPING, marine and naval directory of the United States, published by The Marine Review, Cleveland.

See accompanying index of Advertisers for full addresses of concerns in this directory.

**AIR COMPRESSORS, AIR HOISTS, ETC.**
Great Lakes Engineering Works......Detroit.

**AIR PORTS, DEAD LIGHTS, ETC.**
Marine Mfg. & Supply Co.........New York.

**AIR PUMPS AND APPLIANCES.**
Fore River Ship & Engine Co..Quincy, Mass.
Great Lakes Engineering Works......Detroit.

**ANCHORS.**
Bowers, L. M. & Co.......Binghamton, N. Y.

**ANTI-FRICTION METALS.**
Cramp, Wm. & Sons............Philadelphia.

**ARTIFICIAL DRAFT FOR BOILERS.**
American Ship Building Co.........Cleveland.
Detroit Ship Building Co............Detroit
Great Lakes Engineering Works......Detroit

**ASH EJECTORS.**
Great Lakes Engineering Works......Detroit.

**ATTORNEYS AND PROCTORS IN ADMIRALTY.**
Gilchrist, Albert J................Cleveland.
Goulder, Holding & Masten........Cleveland.
Hoyt, Dustin & Kelley............Cleveland.
Jenkins, Russell & Eichelberger....Cleveland.
Kremer, C. E......................Chicago.
MacDonald, Ray G..................Chicago.
Shaw, Warren, Cady & Oakes........Detroit.
White, Johnson, McCaslin & Cannon Cleveland

**BAROMETERS, MARINE GLASSES, ETC.**
Ritchie, E. S. & Sons.......Brookline, Mass.

**BELTING (LEATHER).**
Republic Belting & Supply Co......Cleveland.

**BLOCKS, SHEAVES, ETC.**
Boston & Lockport Block Co.....Boston, Mass.
Cleveland Block Co................Cleveland.

**BOAT BUILDERS.**
Drein, Thos. & Son.........Wilmington, Del.
Kahnweiler's Sons, David.........New York.
Marine Construction & D. D. Co.........
..........Mariner's Harbor, S. I., N. Y.
Truscott Boat Mfg. Co.....St. Joseph, Mich.

**BOILER COMPOUNDS.**
The Bird-Archer Co............. .. New York
Dearborn Drug & Chemical Works....Chicago.
State Manufacturing Co...............Cleveland.

**BOILER MANUFACTURERS.**
Almy Water Tube Boiler Co..Providence, R. I.
American Ship Building Co.........Cleveland.
Atlantic Works..........East Boston, Mass.
Chicago Ship Building Co...........Chicago.
Cramp, Wm. & Sons...........Philadelphia.
Dearing Water Tube Boiler Co........Detroit.
Detroit Ship Building Co............Detroit.
East End Boiler Works.............Detroit.
Fletcher, W. A. & Co.........Hoboken, N. J.
Fore River Shipbuilding Co.....Quincy, Mass.
Great Lakes Engineering Works......Detroit.
Kingsford Foundry & Machine Works....
.........................Oswego, N. Y.
Maryland Steel Co.......Sparrows Point, Md.
Milwaukee Dry Dock Co..........Milwaukee.

**BOILER MANUFACTURERS—Continued.**
Mosher Water Tube Boiler Co....New York.
Newport News Ship Building Co.........
....................Newport News, Va.
New York Shipbuilding Co.....Camden, N. J.
Northwestern Steam Boiler & Mfg. Co....
........................Duluth, Minn.
Quintard Iron Works Co...........New York.
Roberts Safety Water Tube Boiler Co....
.............................New York.
Superior Ship Building Co.....Superior, Wis.
Taylor Water Tube Boiler Co........Detroit.

**BOILER RIVETS.**
Bourne-Fuller Co.................Cleveland.

**BOILER STAYBOLTS, IRON OR STEEL, HOLLOW OR SOLID.**
Falls Hollow Staybolt Co..Cuyahoga Falls, O.

**BRASS AND BRONZE CASTINGS.**
Cramp, Wm. & Sons............Philadelphia.
Fore River Ship & Engine Co..Quincy, Mass.
Great Lakes Engineering Works......Detroit.
Lunkenheimer Co..................Cincinnati.

**BRIDGES, BUILDERS OF.**
Scherzer Rolling Lift Bridge Co.....Chicago.

**BUCKETS, ORE AND COAL.**
Brown Hoisting & Conveying Machine Co.
............................. Cleveland.

**CABIN AND CABINET FINISHING WOODS.**
Martin-Barriss Co...................Cleveland.

**CANVAS SPECIALTIES.**
Baker & Co., H. H..................Buffalo.
Bunker, E. A. ...................New York.
Upson-Walton Co..................Cleveland.
Republic Belting & Supply Co......Cleveland.

**CAPSTANS.**
American Ship Windlass Co..Providence, R. I.
Dake Engine Co............Grand Haven, Mich.
Hyde Windlass Co.................Bath, Me.
Marine Mfg. & Supply Co.........New York.

**CEMENT, IRON FOR REPAIRING LEAKS.**
Smooth-On Mfg. Co.........Jersey City, N. J.

**CHAIN CONVEYORS, HOISTS.**
Brown Hoisting Machinery Co. (Inc.)....
............................. Cleveland.
General Electric Co........Schenectady, N. Y.

**CHAIN HOISTS.**
Boston & Lockport Block Co....Boston, Mass.
Republic Belting & Supply Co.....Cleveland, O.

**CHARTS.**
Penton Publishing Co.............Cleveland.

**CLOCKS (Marine and Ship's Bell) AND CHRONOMETERS.**
Ritchie, E. S. & Sons........Brookline, Mass.

**COAL PRODUCERS AND SHIPPERS.**
Hanna, M. A. & Co...............Cleveland.
Pickands, Mather & Co...........Cleveland.
Pittsburg Coal Co.................Cleveland.

**COAL AND ORE HANDLING MACHINERY.**
Brown Hoisting Machinery Co. (Inc.)....
............................ Cleveland.

**COMPASSES.**
Ritchie, E. S. & Sons........Brookline, Mass.

**CONDENSERS.**
Great Lakes Engineering Works......Detroit.
Thropp & Sons Co., John E...Trenton, N. J.

**CONTRACTORS FOR PUBLIC WORKS.**
Breymann & Bros., G. H.............Toledo.
Buffalo Dredging Co.................Buffalo.
Dunbar & Sullivan Dredging Co.....Buffalo.
Graves & Stephens................ ... Cleveland.
Great Lakes Dredge & Dock Co.....Chicago.
Hickler Bros.......Sault Ste. Marie, Mich.
Hubbell Co., H. W................Saginaw, Mich.
Smith Co., L. P. & J. A...........Cleveland.
Starke Dredge & Dock Co., C. H..Milwaukee.
Standard Contracting Co............. Clevelnad
Sullivan, M..........................Detroit.

**CORDAGE.**
Baker & Co., H. H.................Buffalo.
Upson-Walton Co...................Cleveland.

**CORK JACKETS AND RINGS.**
Armstrong Cork Co............Pittsburg, Pa.
Kahnweiler's Sons, D.............New York.

**CRANES, TRAVELING.**
Brown Hoisting Machinery Co......Cleveland.

**DIVING APPARATUS.**
Morse, A. J. & Son..................Boston.
Schrader's Son, Inc., A....... ... New York.

**DREDGING CONTRACTORS.**
Breymann & Bros., G. H.............Toledo.
Buffalo Dredging Co................Buffalo.
Dunbar & Sullivan Dredging Co......Buffalo.
Fitz-Simons & Connell Co............Chicago.
Great Lakes Dredge & Dock Co.....Chicago.
Hickler Bros..........Sault Ste. Marie, Mich.
Hubbell Co., H. W................Saginaw, Mich
Smith Co., L. P. & J. A..........Cleveland.
Starke Dredge & Dock Co., C. H..Milwaukee.
Sullivan, M.........................Detroit.

**DREDGING MACHINERY.**
Quintard Iron Works Co...........New York.

**DRY DOCKS.**
American Ship Building Co........Cleveland.
Atlantic Works...........East Boston, Mass.
Buffalo Dry Dock Co.................Buffalo.
Chicago Ship Building Co............Chicago.
Cramp, Wm. & Sons............Philadelphia.
Detroit Ship Building Co.............Detroit.
Great Lakes Engineering Works......Detroit.
Lockwood Mfg. Co.......East Boston, Mass.
Milwaukee Dry Dock Co..........Milwaukee.
Newport News Ship Building Co.........
.....................Newport News, Va.
Shipowners Dry Dock Co............Chicago.
Superior Ship Building Co....Superior, Wis.
Tietjen & Lang Dry Dock Co.....Hoboken, N.J.

**DREDGE BUILDERS.**
Manitowoc Dry Dock Co........Manitowoc, Wis.

**DYNAMOS.**
General Electric Co...........Schenectady, N. Y
Thropp & Sons, John E............Trenton, N. J.

**ELECTRIC HOISTS AND CRANES.**
General Electric Co........Schenectady, N. Y.